AUGUST, 1948

Plant Engineering

TECHNOLOGY DEPARTMENT

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Volume 2, No. 8

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THE BEAVER 48-R....
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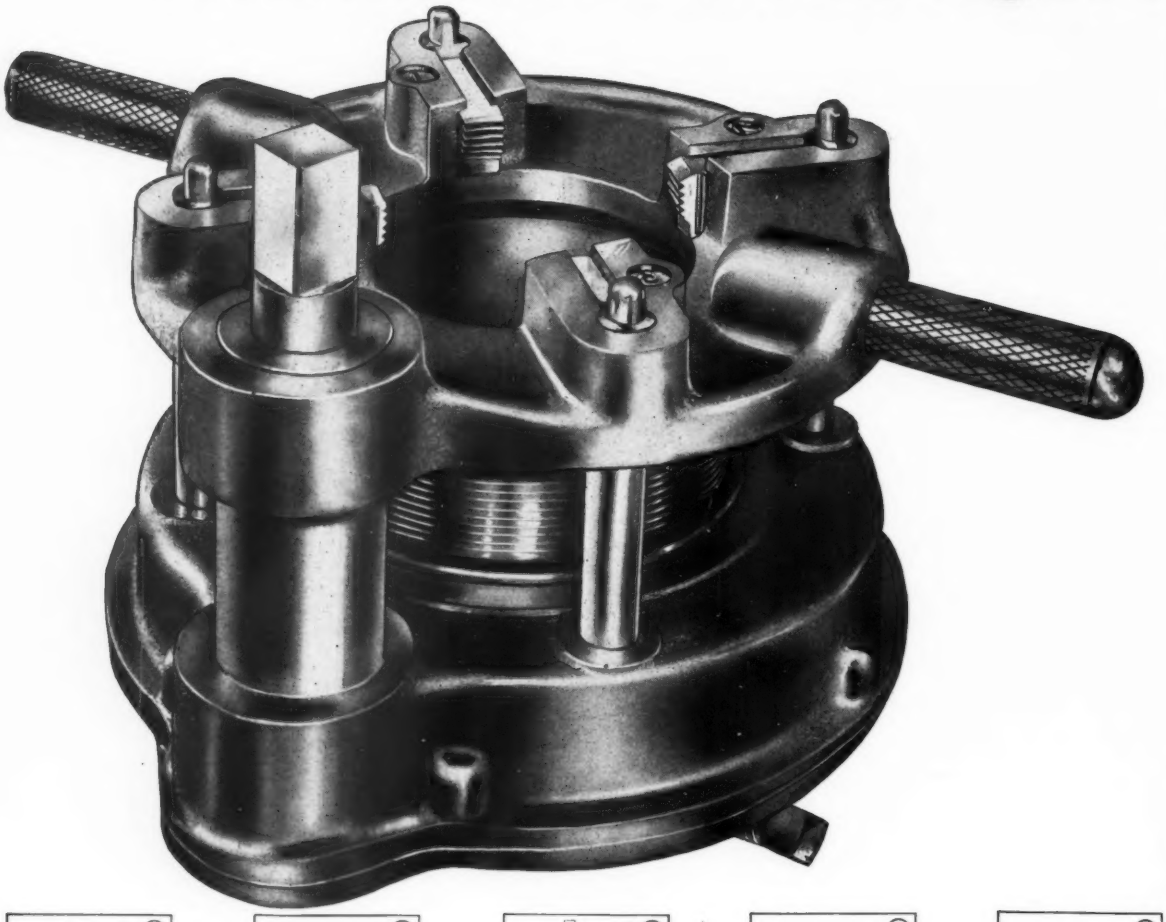
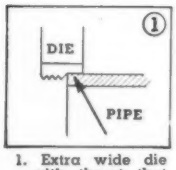
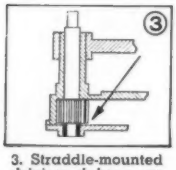


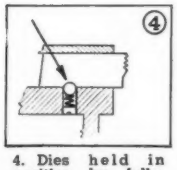


1. Extra wide die —with throat that centers and holds tool in position when placed on pipe.

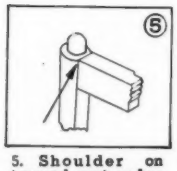
2. Gears fully enclosed and packed in graphite grease —a patented feature which saves costly repair bills.



3. Straddle-mounted driving pinion — an advantage which eliminates repair bills.



4. Dies held in position by fully-enclosed spring-backed ball — dirt cannot get back of it.



5. Shoulder on tapered post makes quick and accurate die setting possible — even under poor lighting conditions.

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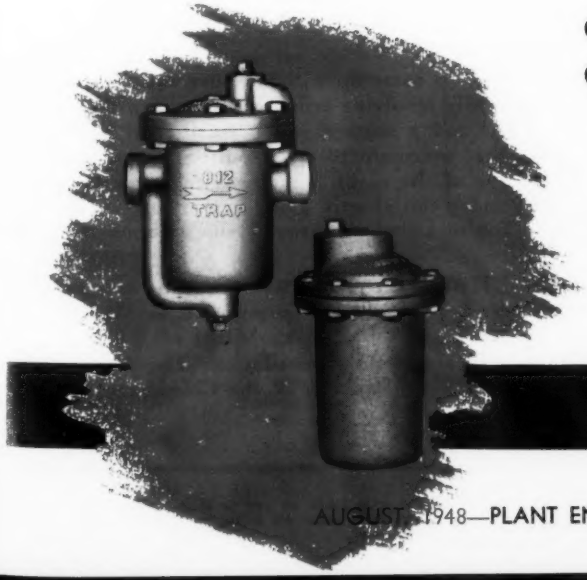

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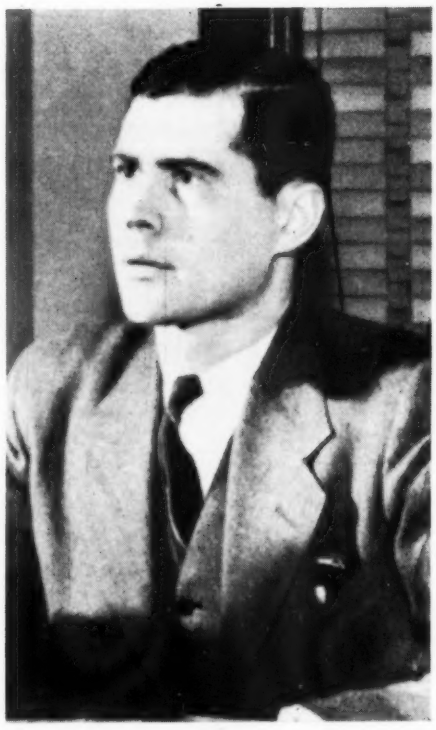
Subscription Information—Published Monthly. Prices: United States and Possessions one year $10.00, Canada one year $11.00. Other countries one year $12.00. Single copies $1.00.



Pic magazine, in its monthly feature "Pic's Job Barometer" (see page 15) selected a practicing plant engineer, well known to readers of *Plant Engineering*, for the subject of its supplementary case study. Perry Kavanagh has written several articles for this magazine and more are scheduled to appear in future issues. The case study is presented on this page in much the same form that it appeared in the July issue of *Pic*

Plant Engineer

Being financially embarrassed after three years at Yale University is what probably determined Perry Kavanagh's career. He had to quit school, then spend more than a year in miscellaneous construction work in New England, followed by another year as a licensed plumber in his home town, Rutland, Vermont. With this practical experience under his belt and some change in his pocket, he returned to Yale to complete his course in industrial engineering and administration. He was graduated in 1939.

Following graduation, Kavanagh worked for five years in the Plant Engineering Department of Yale, spending much of his working time in the New Haven Hospital. As an indication of what a plant engineer is up against, one of his assignments, in connection with some gas experiments, was to make a sprayer which would automatically give a hot salt shower to a reluctant pig every 15 minutes, day and night.

Another time, the doctors came up with the idea that babies would rest better in slowly revolving cribs. So Kavanagh made an experimental model and a mother was persuaded to leave her baby at the hospital overnight to try it out. She changed her mind in the middle of the night, went back for baby and found him sleeping under the ghastly glow of mercury vapor lamps. Screaming "You've killed my baby!", she grabbed the child and fled.

After leaving New Haven, Kavanagh worked two years as assistant plant engineer for the Wyeth Corporation of Mason, Michigan, then nine months at the Chicago plant of Western Electric working on air conditioning installation. The former Vermont plumber is now plant engineer of the Chicago Screw Company.

Plant Engineering is published monthly at 53 W. Jackson Blvd., Chicago 4, Ill. Subscription price $10.00 per year to U. S. A. $11.00 to Canada. $12.00 to other countries. Single copy $1.00. Application is pending for acceptance under Act of June 5, 1934.

Jenkins PRACTICAL PIPING LAYOUTS 34

How to plan STEAM and WATER PIPING FOR A DYE PLANT

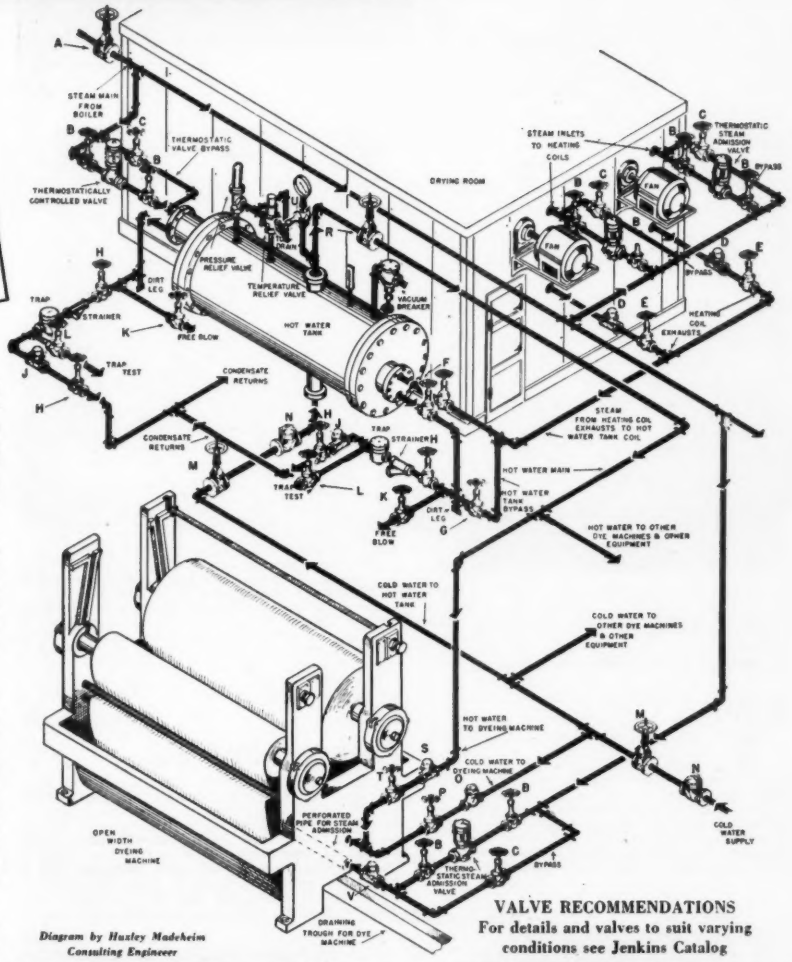


Diagram by Huxley Madeheim Consulting Engineer

This typical dye plant hookup, includes a dyeing machine, hot water tank and drying room connections. The main steam line furnishes primary heat for the dyeing machine and drying room, and auxiliary heat for the hot water tank. Exhaust steam from the drying room furnishes primary heat for the hot water tank.

The cloth passes through the vats containing dye in water solution which is kept at the required temperature by thermostatic controls. This solution is heated by steam admitted through the perforated pipe. After material has been dyed, it is transferred to the drying room.

If exhaust steam from the drying room is inadequate to heat the amount of water required, the thermostatically controlled auxiliary steam coil fed directly from the main steam line goes into operation. The exhaust steam line from the drying room to the hot water tank should contain a bypass around the tank to condensate return lines. This will allow operation of the drying rooms when the primary heating coil in the hot water tank is not in operation.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation. Copies of Layout No. 34, enlarged, with additional information, will be sent on request.

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C	4	Fig. 956 Bronze Globe	Manual Control, Automatic Valve Bypass
D	2	Fig. 92 Bronze Swing Check	Prevent Backflow to Heating Coils
E	2	Fig. 370 Bronze Gate	Heating Coil Shutoff
F	2	Fig. 370 Bronze Gate	Hot Water Tank Heating Coil Shutoff
G	1	Fig. 106-A Bronze Globe	Exhaust Steam Bypass of Heating Coil
H	4	Fig. 370 Bronze Globe	Trap Shutoff
J	2	Fig. 92 Bronze Swing Check	Prevent Condensate Backflow
K	2	Fig. 106-A Bronze Globe	Free Blow on Condensate Lines

Code	Quan.	Jenkins Valves	Service
L	2	Fig. 106-A Bronze Globe	Trap Test
M	2	Fig. 651 IBBM Gate	Cold Water Supply Lines
N	2	Fig. 295 IBBM Swing Check	Cold Water Supply Lines
O	1	Fig. 352 Bronze Swing Check	Cold Water Supply to Dye Machine
P	1	Fig. 106-A Bronze Globe	Cold Water Supply to Dye Machine
R	1	Fig. 651 IBBM Gate	Hot Water Supply Shutoff
S	1	Fig. 92 Bronze Swing Check	Hot Water Supply to Dye Machine
T	1	Fig. 106-A Bronze Globe	Hot Water Supply to Dye Machine
U	1	Fig. 106-A Bronze Globe	Pressure Gage Control
V	1	Fig. 92 Bronze Swing Check	Prevent Back Flow to Steam Line

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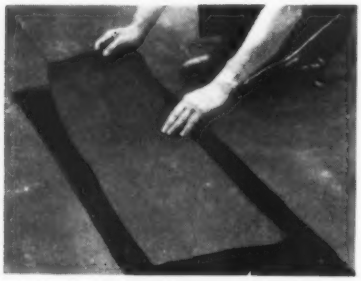
New Products and Methods

WHAT'S NEW? Here industrial ingenuity is summarized for your quick review. If you want additional information or have questions on specific applications use the addressed-no obligation, no postage-card between pages 10-11 and 42-43

Roof Repair System

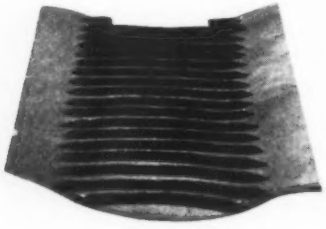
1 Announced is a roof repair system for which this firm has prepared rather complete analyses. Many different types of roofs and joints and the materials that can be used to repair them are taken into consideration. Company claims there is a correct process for each type of material to be repaired.



On the basis of this claim it has prepared many sheets of instructions dealing with each type. It also furnishes quantity estimates so that the cost of a repair job may be estimated. United Laboratories, Inc.

Ribbed Conveyor

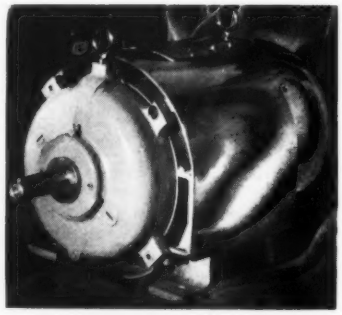
2 A new ribbed-top conveyor belt designed especially to prevent backslip in carrying sand and gravel, wet-mixed concrete, gold dredgings and other soupy materials up steep inclines, has been developed. The new belt features chevron-shaped ribs $\frac{1}{4}$ in. higher than the belt surface. The ribs serve as barriers, trapping the water and preventing the backwash of materials down the belt



on inclines up to a 20 deg angle. The ribbed cleats also increase belt-life by reducing the severe wear a back-slipping load inflicts. The curved ribs are closely spaced to overlap each other and assure a smooth return run of the belt over idlers. The new belt has a five-ply rubberized fabric body, and a $\frac{1}{4}$ in. top cover in addition to the ribs. It is being made in widths of 30 to 48 in., and in lengths to specifications. Goodyear Tire & Rubber Co.

Chemical Motor

3 A corrosion-resisting ac motor for general application in the chemical industry has been developed, and will be offered in frame sizes 203 through 426. Built to standards set by the Underwriters Laboratories for operation in Class I-Group D, for locations in hazardous conditions, the new motor has also been made explosion proof. By the addition of a multi-conductor cable, rubber hose, and suitable packing glands, the motor also meets the specifications of the

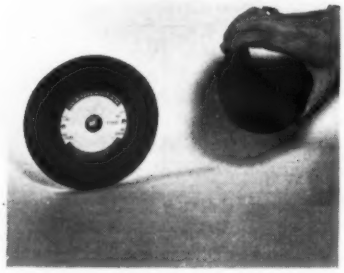


Bureau of Mines for use on permissible equipment.

Monel metal has replaced steel in the outer cover of the new motor, in the fan cover, and in the construction of the lead outlet where the usual steel channel has been replaced as a lead enclosure with a monel pipe nipple going directly into the inner enclosing shell. Cast bronze is used for the fan, and grease and bearing protection by the addition of bronze shaft collars. Brass is used in the grease pipes and in the screws which hold on the fan cover. Bolts holding the outer fan are of cadmium-plated steel. Fine-grained cast iron replaces pressed steel in the construction of the conduit box. Reliance Electric & Engineering Co.

Grinding Wheels

4 For the spots that have to be ground and cannot be reached with a standard wheel this firm is offering a flexible grinding wheel. The basic bonding and flexing agent of these wheels is Neoprene. This agent has high heat resistance and adhesion between the grit and bond. It is said that Neoprene does not soften from the heat generated but wears away evenly so that new abrasive



particles are continually exposed to the work. These wheels have been used in grinding stainless steel, copper, aluminum, Monel, brass, and plastics. Wheels are produced in soft, medium, or hard grades, and in grit sizes from 46 to 240. Raybestos-Manhattan, Inc. Manhattan Rubber Div.

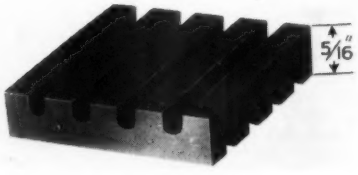
Electronic Counter

5 The three sequence predetermined electronic counter which will predetermine three different counts that occur in sequence, each of which can be any number from 1 to 10,000. The output consists of three high speed mercury type relays. Each is energized at the completion of its associated count. In the predetermined counters only one set of counter decades is used for all of the selected predetermined counts. This is accomplished by presetting into decades the complement of the desired predetermined count. In other words, at the completion of the first selected count, the complement of the second predetermined count is electronically preset into the decades. Then at the end of the second selected count the complement of the third predetermined count is preset into the decades.

The desired counts can be selected by additional rows of dial switches, as indicated in the Three Sequence Counter which contains three rows of dial switches. For control systems which require a large number of different predetermined counts occurring in sequence, the dial switches can be eliminated and a punched tape which is sensed and indexed can be used for presetting the counter at the end of each count. With this system any number of predetermined counts can be selected. Potter Instrument Company.

Machine Mounting Pads

6 A new type of vibration absorber which combines the ease of installation of pad type cushions with the effective absorption of the molded type suspension has been developed. These mounting pads are of resilient Neoprene composition. Flexibility is combined with

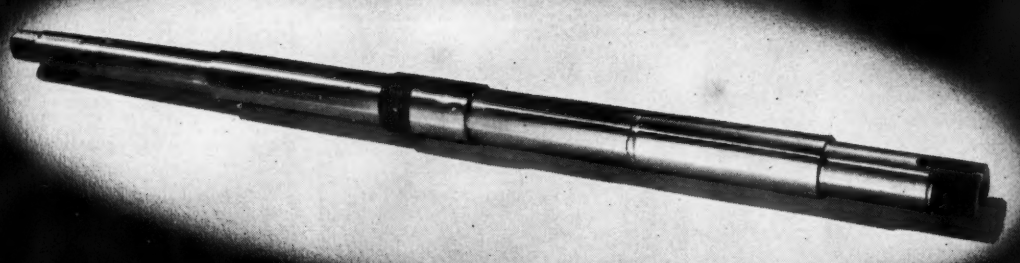


stability in all directions and the design provides efficient absorption of both vertical and side-thrusting impulses. Standard pads are $\frac{5}{16}$ in. thick, and as large as 18 by 18 in. Single thicknesses are usually sufficient for loads of 30 to 50 psi. Multiple thicknesses may be used for heavier loads. M B Mfg., Co., Inc.

Riding Lift Truck

7 The maker of this truck claims that it is handier because it has a short overall length. There are several interesting features about the truck; one is the swivel seat with which the driver may face to or away from the load. The two speeds are controlled by a deadman pedal which automatically applies the brake upon release. The truck is available in 2 models, 3000 and 5000 lb, with the former having a speed of 3.5 mph and the

What do you want in a pump shaft?



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- **High resistance to fatigue caused by stress, vibration, and pulsation.**
- **Strength equal to that of steel.**
- **And if you need special properties, there is *"R" Monel* for high-speed production machining; *"K" Monel* that is heat-treatable to tensile strength higher than 150,000 psi; *"KR" Monel* that is both free-machining and heat-treatable.**

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Case 2. A pump manufacturer had difficulty making long, thin shafts for multi-stage high pressure pumps. Stresses set up during machining caused the shafts to deform and fail in service. Heat-treatable *"K" Monel* was tried—and proved to be the solution to this problem, too.

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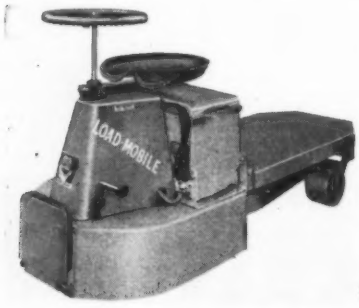
New Products and Methods

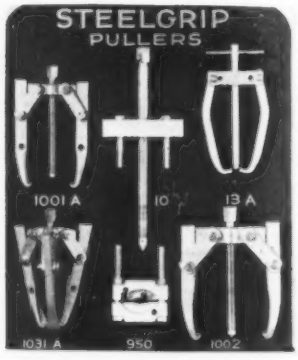
latter 3 mph. Lengths of 36 in. platform are available and up to 72 in. will soon be available. Width of all units is 26 in.



Heights will be the standard 6, 7, 9, and 11 in. lowered. Lift is 4 in. Battery has a capacity of 340 amp hr. Each wheel has two full sealed ball bearings. The storage battery is easily detachable. Market Forge Co.

Gear Puller Rack

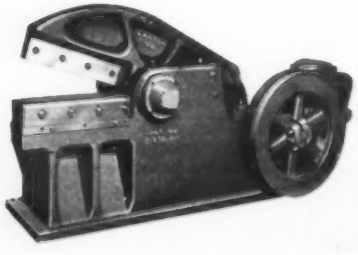
8 Announced by this maker of wheel, gear, and pulley pullers is a tool rack to hold the pullers that it makes. This rack is suitable for setting up in tool rooms or maintenance



shops whichever is most convenient for the men who use the pullers. Rack is of thin sheet steel and large enough to hold six of the pullers. Brackets for holding the tools are built right onto the assembly. Armstrong-Bray & Co.

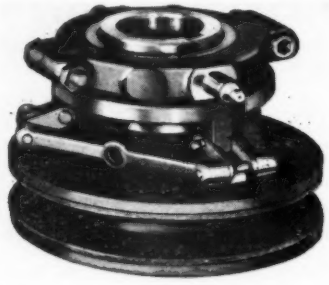
Scrapping Shear

9 Announced is a new size shear with an adjustable knife seat which eliminates shimming after knives have been reground. Bronze bushings on all moving parts is another improvement over previous models. The new shear, known as the CANTON No. 11-A, has a capacity of 2 in. square, or 3/8 x 24 in. in mild steel. Canton Div., Hill Acme Co.



Friction Clutches

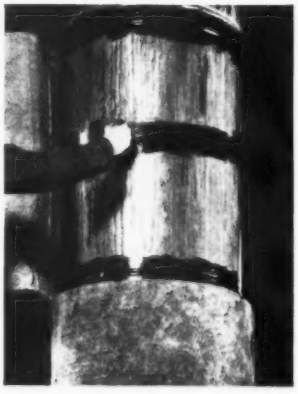
10 Announced is a complete new line of friction clutches for industrial use. The clutches embody the over-center design. These toggle-type, over-center clutches are adapted for use in a wide variety of installations. The same over-center principle used in high-torque, heavy-duty tractor and hoisting clutches is incorporated in this small, compact design. The toggles are factory-assembled with the release mechanism and adjusting plate. The entire assembly comes off in one piece when the clutch is disassembled. As an aid to maintenance and inspection, there are no small, loose pieces to fall out and get lost during disassembly. Small diameter clutches are available in capacities ranging from 5 to 1.7 hp per 100 rpm. Engineering ingenuity applied to design has made it possible to effect a wide range of applications with only two basic designs, plus a small selection of driving cups. Morse Chain Co.



Do you want more information on this equipment and its application? Use the no obligation, no postage card between 10-11 and 42-43

Duct Insulation

11 Two Fiberglas materials for the insulation of ducts are announced. Fiberglas coated duct insulation, for hot or cold ducts, is a lightweight material in board form, with a coating on both surfaces that provides excellent handleability. It can be cut accurately with a knife to conform to irregular shapes and curved surfaces, and can be scored to take a gradual or sharp bend. The coated surface can be painted, or covered with asbestos paper or canvas. Thermal conductivity is approximately 0.26 at 75 F. Density is 6 lb per cu ft.

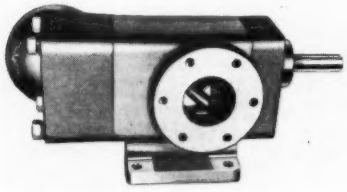


Fiberglas flexible duct insulation is an uncoated, extremely light-weight material designed primarily for application on concealed, hot or cold ducts where finish is not required. Two densities and weights are available: 0.5 lb per cu ft, weighing 0.021 lb per sq ft; and 1.0 lb per cu ft, weighing 0.042 lb per sq ft. Thermal conductivity is 0.23 to 0.25 at 75 F.

Both the coated and flexible duct insulation materials will dry out rapidly if wetted, with original efficiency unimpaired. The glass fibers will not burn or support combustion, will not rot, and will not corrode metals. Owens-Corning Fiberglas Corp.

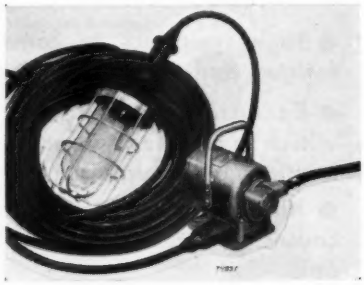
Helical Rotor Pumps

12 Announced is a line of positive displacement, simple, helical rotor pumps. Two helical rotors, one a driving rotor and the other an idler rotor, force the liquid ahead in an axial flow in volume and at pressure. The shaft of the driving rotor is mechanically sealed by an anti-friction shaft seal against leakage. Built in two sizes these pumps are primarily designed for handling various grades of oils at either 50 or 75 gpm, at pressures of up to 125 psi in a smooth, pulseless flow. Syntron Co.



Air Driven Generator

13 The AL-150 Airlite will supply ample power to operate two 75 w, 115 v, bulbs. Light for working in dark locations on construction, repair and public utility jobs, is now available without stringing temporary electric lines to the job. The Airlite cannot be harmed by short circuits or overloads, if the output terminals are directly shorted, light is restored the instant the short is removed.



Compressed air not only powers the tools that do the work, it now also lights the job. The unit is a perfect companion for every portable compressor. It weighs 8¾ lb and measures only 7¼ by 5 by 5 in. without handle. Both 115 v and 220 v models are available. Compact and enclosed construction make the Airlite a foolproof unit. Ingersoll-Rand Co.

Threadless Fittings

14 The new line in bronze fittings is said to give pipe fabricators a freedom of choice between ferrous and non-ferrous piping. They are threadless bronze pipe fittings for brazing to I.P.S. brass or copper base alloy tubing or pipe, and the one-piece system that results, is as strong as the pipe itself, yet easy to install at low cost. The fittings are applicable for 150 lb. wsp lines at 410 F, or 300 lb non-shock cold-water, oil, or gas lines.

With the same wall thickness and center-to-end dimensions as standard bronze fittings, it can be used with thin-wall brass, copper pipe or tubing. The full strength of the pipe wall is utilized, since there is no loss of wall thickness by threading. With no threads to weaken the joint,

THERMOBLOC

A REVOLUTIONARY NEW UNIT HEATER

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DIRECT FIRED
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EASILY INSTALLED
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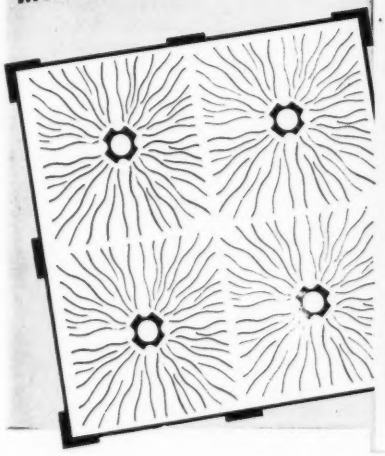

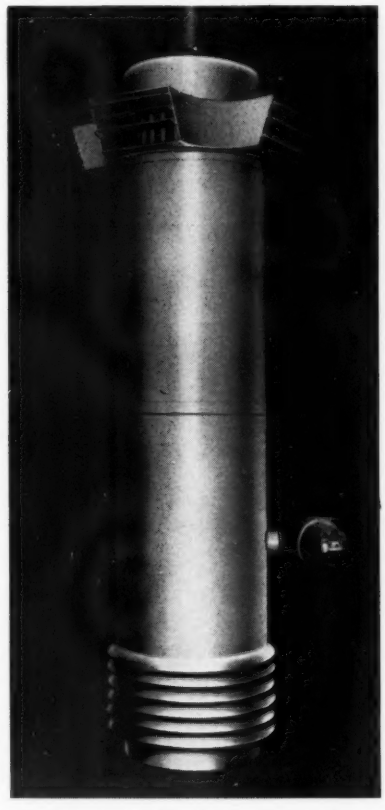

EFFICIENCY 82 TO 86%
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HEAT WHERE YOU WANT IT, WHEN YOU WANT IT
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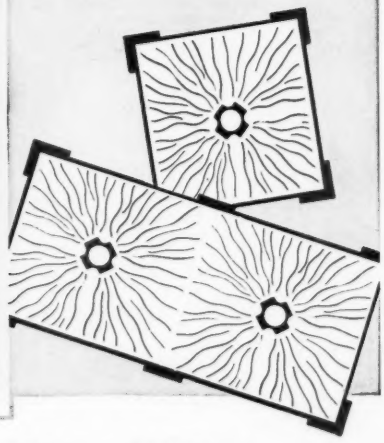
(refer to diagrams below)



MAY BE USED AS A HEATER — CIRCULATOR — DRYER

Thermobloc is a strictly new, direct-fired unit heater. Revolutionary in design, only 30 inches in diameter, delivering warm air at the working level without draft. Heat output of 550,000 b.t.u.'s per hour has been found to be best suited for draft-free heating. Where more heat is necessary, more than one unit should be installed to deliver the warm air where it is required. Such multiple installations are shown on the above typical plan layout sketches.

Thermobloc is shipped ready for operation, the only installation requirement is an oil or gas line and power connection. This eliminates costly installation, required by steam or hot water heating systems. Completely automatic operation requires no attendant. One or more Thermobloc units, strategically placed in the space to be heated, supply uniform temperature in the winter and gentle, draft-free circulation of cool air, drawn from the floor level, in the summer.

Information on other applications will be sent on request. Clip coupon and attach to your company letterhead.

THERMOBLOC DIVISION

PRAT-DANIEL CORPORATION

72 Water St., E. Port Chester, Conn.

Thermobloc Division
PRAT DANIEL CORPORATION
72 Water St., E. Port Chester, Conn.

I would like to have further information on the New Thermobloc Unit Heater. My heating requirements are sq. ft. floor space.

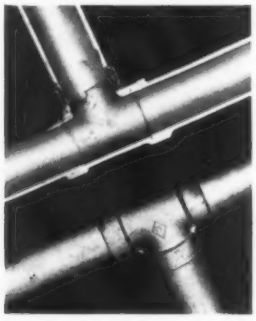
NAME_____

COMPANY_____

ADDRESS_____

New Products and Methods

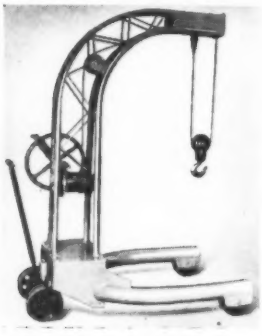
the full depth of the socket of the fitting is brazed to the pipe. Interior design of the fitting tends to reduce turbulence, because the internal diameter of the fitting is the same as the internal diameter of the pipe or tubing. Close tolerances in the machining of the cups insure rigid



support and a thorough bond. Threadless bronze fittings, according to the manufacturer, can be used to great advantage in confined spaces where it is difficult to use a pipe wrench, or in locations inaccessible for maintenance after installation, and on lines subject to vibration, contraction, or expansion. Flagg Co.

Portable Crane

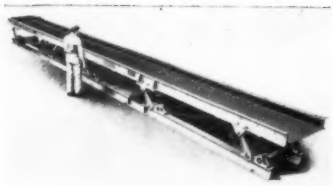
15 A new line of portable cranes for handling loads where overhead lifting equipment is not available is announced. These new cranes, made of welded steel, weigh less than half as much as previous models. Two-speed operation is provided by means of a single or double cable for light or heavy loads.



Adjustable extension handle gives additional leverage for extra heavy loads. A self-locking worm mechanism holds the load with safety at any point. Now available in all models of one to three ton capacity. Greater strength, lighter weight and safer operation are the outstand.ng features. Canton Div., Hill Acme Co.

Oscillating Conveyor

16 The new PA Oscillator is a positive-action, roller bearing, eccentric type oscillating trough feeder-conveyor, driven by an Electrofluid Drive through a chain or V-belt reduction to the machine's eccentric shaft and connecting rod assembly. It is available in standard trough widths of 12 to 48 in. to suit the capacity desired and character of the material to be handled—and in single trough lengths of up to 100 ft. For longer carrying runs, two or more units may be arranged in series, one discharging into the other, and each equipped with an individual motor drive. Besides conveying material, the new PA Oscillator may also serve as a cooler, dryer or conditioning unit



when jacketed, louvered or otherwise constructed for the service intended. The trough is either pan type or constructed with channel steel sides. The standard trough is leak-proof and can be furnished with dust-tight covers or constructed for air and gas tight movement of the material. Conveyor trough can also be fabricated of corrosion and heat resistant metals. The trough is supported on a series of short arms and adjustable torsion bars, having the effect of reactor springs. These springs absorb the energy of trough-movement at each end of the stroke, at all points of support throughout length of trough.

The torsion bars and supporting arms are assembled in pairs, in common bases or mounts on an H-beam sub-frame, with each arm supporting one side of the trough. Each torsion bar is fixed at one end, and is free to articulate in a steel-backed rubber bushing on other end, on which trough-supporting arm is mounted and keyed. Fixed end can be adjusted by means of set screws acting upon a self-energizing clamp which holds the bar. Link Belt Co.

Velocity Power Driver

17 In less than twenty seconds, Model "B" Velocity Power Driver is said to anchor pipe hangers and conduit boxes to structural plate or concrete. Heating and ventilating ducts; gas, water, fuel, and sprinkler lines; theater

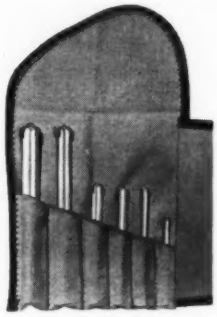
seats; signs; guard rails, all are within the scope of this recently introduced tool. Being completely self-contained the tool may be operated in any position or location, entirely independent of trailing cables, hoses, or outside sources of power. It's operation is comparatively silent, flashless and without recoil. Mine Safety Appliances Co.

Compound

18 A new product called Anti-Capillary Compound is available. For use with Low Temperature Welding Rods, this paste is designed to confine the flow of molten alloys to the limited area upon which the weld is to be applied. Available in standard size jars, this Anti-Capillary Compound protects the parent metal from discoloration at welding temperatures and thus assists in retaining the cleanliness and brightness of the metal. In addition, the possibilities of distortion are greatly lessened, with the temperature being confined to the specific area under consideration. For thin-flowing alloys that may flow easily over the surrounding surfaces in addition to the weld area, this compound helps limit the flow and retain the molten metal to that area being welded. The compound can be used with any form of heat, oxyacetylene gas torch, soldering torch, soldering iron, furnace and high-frequency applications. It may easily be applied by painting or spraying with any type brush and may simply be removed by mechanical action, quenching, wire brushing or sand blasting. Eutectic Welding Alloys Corp.

Masonry Drills

19 A new all-purpose line of carbide tipped masonry drills, including both round-shank drills for shallow holes and fluted-shank drills for deep holes, has been announced. Drills are said to be ideal for the rotary drilling of all kinds of masonry; concrete, brick, slate, plaster, marble, asphalt, limestone, and for a wide variety of jobs including plumbing work, anchoring partitions, making telephone installations, sign hanging, and even drill press work. The round-shank

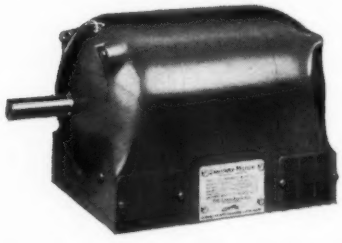


drills are recommended primarily for drilling comparatively short holes such as anchor bolt holes. Fluted-shank will also drill holes as deep as the drill shank can reach.

The new Carboloy masonry drills come in 3 handy kits. Kit No. 1 contains 6 round-shank drills for shallow-hole drilling, ranging in diameter from $\frac{7}{32}$ to $\frac{5}{16}$ in. Kit No. 2—the universal kit for both shallow-hole and deep-hole drilling—contains three round-shank and three fluted-shank drills in six sizes ranging from $\frac{7}{32}$ to $\frac{5}{16}$ in. diameter. Kit No. 3—a large size range kit for universal drilling—contains two round-shank and four fluted-shank drills ranging in diameter from $\frac{1}{4}$ to $\frac{3}{4}$ in. All kits are suitably tagged for quick identification. The drills are also available packaged individually or in quantities of the same size. Carboloy Co., Inc. Detroit 32, Mich.

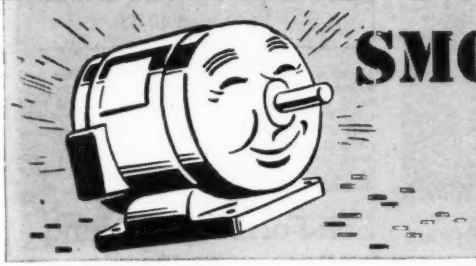
Sanitary Motor

20 Developed is a sanitary motor for use in dairies, food process, canning and beverage plants. This new motor incorporates a number of features to improve the average machinery installation in any type of manufacturing plant where sanitation is essential. The motor is streamlined and free of cracks,



recesses or depressions where milk or food products can collect. Smaller ratings will be supplied in the totally enclosed, non-ventilated construction which prevents the entrance of vermin into the motor when it is shut down for the day. Larger ratings are splash-proof and will be supplied with removable stainless steel grille plates over the cooling air inlets and outlets, also making it vermin-proof. All sizes can be washed down to insure maxmium sanitation. One of the outstanding features of this Sanitary Motor is the base construction. The entire base in enclosed by the motor housing which is finished to a flat surface. This prevents the collection of milk or food particles under the motor which is one of the biggest objections to the use of

NO DANGER AHEAD!



SMOOTH-WORKING MOTOR

. . . THIS

TESTING INSTRUMENT HELPS SPOT TROUBLE BEFORE IT HAPPENS

You can detect overloaded motors and consequent production delays with this handy G-E hook-on volt-ammeter (Type AK-1). You can save yourself expensive headaches and assure smooth, continued operation within your plant by catching trouble before it starts.

6 INSTRUMENTS IN ONE

Here's the way the AK-1 works: hook it around a conductor, flip the selector switch to AMPERES, and there's your current measurement. For voltage measurement, just connect the voltage leads, snap the switch to VOLTS, and take the reading. No cutting of conductors, no interruption of service . . . yet in an instant it gives you the information you need. Actually it's a six-in-one instrument, as it has six ranges: 0-15/60/150/600 amp and 0-150/600 volts (for a-c circuits only).

AVAILABLE TODAY

Don't let overloads cause burned-out motor windings or deterioration of insulation—resulting in expensive repairs or replacements. Keep your motors running smoothly by periodic checks with an AK-1, available from stock today. See your nearest G-E apparatus distributor or agent, or write for Bulletin GEA-2950 to get complete details on this versatile instrument. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

HOOK-ON VOLT-AMMETER

TYPE AK-1, AC ONLY

MEASURES BOTH VOLTS AND AMPS

NO CUTTING OF CONDUCTORS
NO INTERRUPTION OF SERVICE

$69.75 WITH VOLTAGE LEADS

GENERAL ELECTRIC

602-115

New Products and Methods

the conventional foot mounted motor in an application of this type. Mounting holes are located in accordance with NEMA standards permitting this motor to be completely interchangeable with motors now in use. Access to the mounting bolts is through the removable grille plates. Louis Allis Co.

Textile Motor

21 An improved Quick-Clean textile motor with prelubricated, double-width, double-sealed ball bearings which is said to make servicing practically unnecessary for five-year periods, has been announced. The redesigned motor has heavy section cast iron bearing brackets with large openings, specially machined and finished to prevent building up of lint. Stator yoke is of cast iron with a specially designed external contour which provides a smooth non-obstructing flow to the ventilating air after it passes through the

openings in the bearing brackets. Stator winding utilizes heavy insulated copper. Coil ends are enclosed with bakelite shields held in place by silicon compound and self-tapping screws which fit into drilled holes in the outside edges of the yoke. Rotor cage is die cast with integrally-cast fans of special design to give the ventilating air the velocity and direction necessary for prevention of lint accumulation.

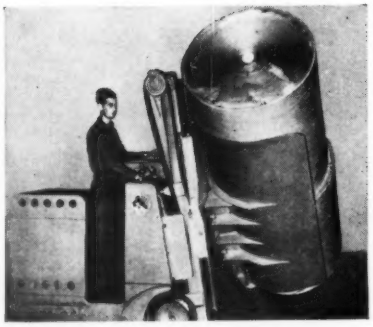
The motor, available in 3, 5, 7½, 10 and 15 hp sizes, is suitable for spinning, twisting and roving frames and other applications common in textile mills. Norwood Works, Allis Chalmers Mfg., Co.

Monel Roofing

22 A new type of Monel sheet for roofing purposes has been developed. This new sheet has the mechanical and corrosion resistant properties of the roofing sheet previously produced except that it is softer in temper and lends itself more easily to the various bending, forming, seaming and soldering operations required for roofing purposes, thus cutting fabrication and installation costs. Available in standard roofing thicknesses, it can be used for nearly all types of roof construction. It is already being used for such structural purposes as skylight framework, penthouse sidings, through-wall flashings, cap and base flashings, gutters, cornices, and downspouts as well as complete roofs. The sheet, while easy to form, is tough and hard. It has a low coefficient of expansion, high rigidity, is not subject to fatigue cracking, and remains unaffected by sudden temperature changes which normally affect most metallic roofing materials. International Nickel Co., Inc.

Rotating Carriage

23 A hydraulically operated rotating carriage has recently been developed for use with power fork trucks. This carriage, when used in conjunction with the paper roll attachment, requires only 90 deg of the full rotation. The paper roll attachment for use with this rotating carriage consists of a full curved backplate, designed to fit the contour of the rolls, and a polished and ground toe plate with a beveled leading



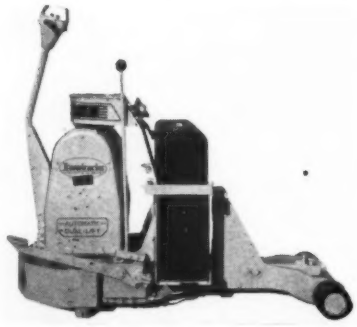
edge for entering under the headings of paper rolls without damaging them. The rolls may be either picked up or deposited in a vertical or horizontal position. Other attachments can be used for small castings, scrap metal, coal, or grain. Lewis-Shepard Products Inc.

Air-Drying Coating

24 Easier application, without primer, increased corrosion-resistance efficiency, and durability are among the factors that are said to be features of a new product. It is for use in tanks, fermenters, carbonated beverage equipment, driers, pipe fittings, filter bodies, bottling equipment, and scores of other uses in pharmaceutical, food products, paper and pulp, breweries, and chemical industries. LC-600 embodies important newly developed properties based on inert synthetic resins. It may be sprayed, dipped, flowed, roller coated, or brushed on almost any clean, unpolished, de-rusted surface. It is resistant to acids, alkalies, chlorides, oils, salts, oxygen and alcohol solutions. Electro-chemical corrosion is inhibited by its high dielectric strength. It contains no vegetable oils causing oxidation, or deterioration with age. It is odorless and tasteless. Lithgow Corp.

Lift Truck

25 A new lift truck for handling live and semi-live skids is said to provide full driving traction when lifting heavy loads, maneuverability equal to that of a hand lift jack, and capacity to handle skid loads of literally any size. Weight of the unit is 1000 lb.



It is made in this one size only. Batteries required are the standard 11-plate battery of a motorized hand truck. Unit can jackknife to nearly 90 deg to handle in tight spots. Automatic Transportation Co.

Small Rotary Plane

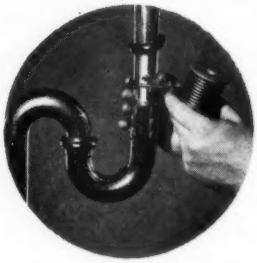
26 A planer with positive, precise cutting action on balsa and hard wood, plastic, aluminum and metal is announced. This tool enables the operator to plane, groove, tenon, rabbet, panel, and rout accurately. It eliminates scraping or tearing in hard, medium, or soft woods, irrespective of grain position and easily cuts up to ¼ in. depth, leaving a finish that requires almost no sanding. Fitting any drill press, the Derry Rotary Plane comes fully equipped with standard tool bits with the proper cutting edge for

Do you want more information on this equipment and its application? Use the no obligation, no postage card between 10-11 and 42-43

wood work. Tool bits for use on plastic and aluminum and for making square-shouldered cuts are available also, or special tool bits will be made to fit individual specifications. All tool bits are made of special high speed tool steel and are ground for long cutting life. When dull, they are easily removed for sharpening. Scientific Engineering Corp.

Self-Forming Packing

27 In rope form, this metallic, self-forming, self-lubricating packing is furnished on a handy ½ lb. spool. Manufacturers claim superiority of product's performance, in tests and use, over old conventional type. Stands up in lines carrying cold or hot water, steam, air, gas, brine, ammonia and other mild chemicals. To pack, just unwind from



spool, place around pipe, tighten coupling-nut, and packing makes a perfect lasting ring-type seal. Serves equally well on mixing faucets, line and radiator valves, spigots, jiffy joints or any fitting where packing or washer is required. Flexrock Co.

Safety Light

28 A one-watt fluorescent night light for dark hallways and steps is now available. The walnut-size lamp, for use on 110-125 v ac service, costs so little to operate, 2½ cents a month for around the clock use—that most users are expected to burn it continuously for convenience. The new lamp, has an average life of one year. It has a two-prong base for plugging into baseboard or wall outlets. Westinghouse Electric Corp.

Fluid Transmissions

29 These new variable speed transmissions consist of a volumetric, variable delivery, radial rolling piston pump driving a constant displacement radial rolling piston motor. Oil, as the fluid power, flows from unit to unit through adequately proportioned passages, it provides automatic forced and flood lubrication, and insures long life. A compact case encloses the operating mechanism while integral relief valves in fluid passages protect installation against overload. Oil reservoir can be integral with machine or separate. To accommodate the cycle and functional requirements of a wide variety of applications, these transmissions with several tried and proven control devices are offered:

Hand screw control for accurate setting of output shaft speed, from zero to maximum, in either direction with 3.4 turns of a small graduated knob on side of transmission. Hydraulic servo-motor lever control for stepless variation of output shaft speed in either direction and for quick reversal of rotation by finger tip actuation of a small lever. Hydraulic two-speed control for remote selection of adjustable preset speeds in either direction or fast and slow speeds in one direction. Electric three-position remote control for independently adjustable pre-set speeds in either direction and neutral or idle position selected manually or automatically from convenient remote pushbuttons or switches. Oilgear Co.

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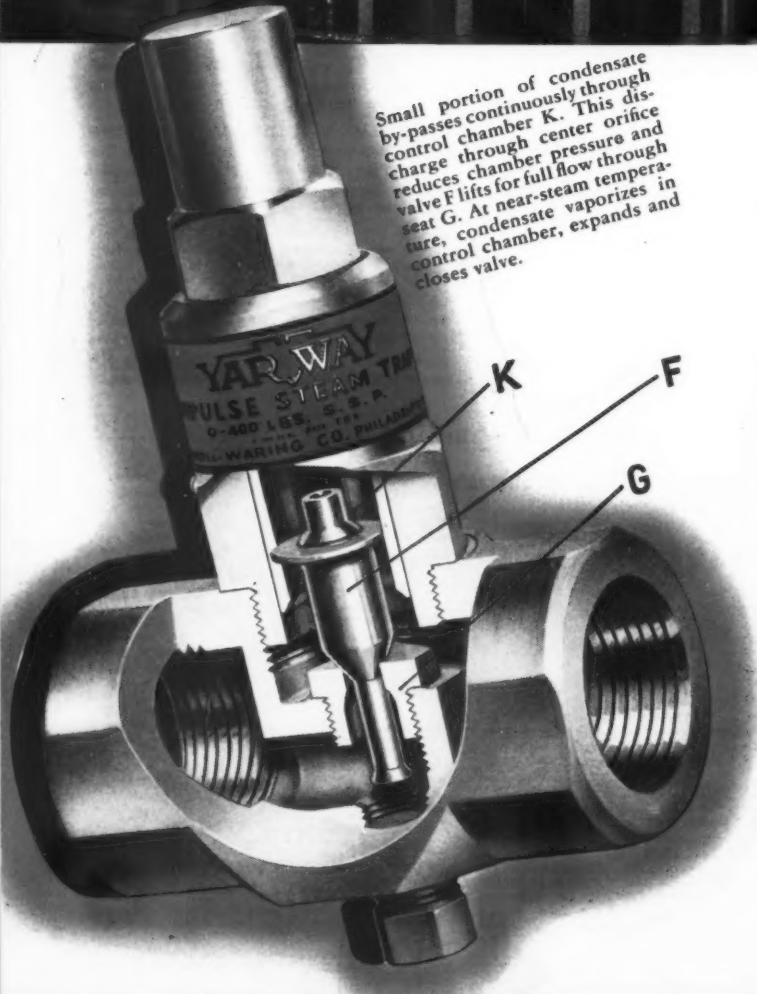

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In a copyrighted feature on pages 62 and 63 of the July issue of *Pic* magazine, plant engineering is analyzed as a profession to which young men of imagination and ability should give serious consideration. The case study from page 92 of *Pic* is reprinted on page 4 of this issue of *Plant Engineering* This case study is on Perry Kavanagh, a practicing plant engineer and an author well known to readers of this magazine

Selection of Greases for General Plant Use

By H. A. McCONVILLE, *Works Laboratory, General Electric Co., Schenectary, N. Y.*

ONE OF THE important considerations in the successful operation of equipment in the average industrial plant is to keep the plant machinery well lubricated.

This naturally involves a great many types of machinery, and suggests that a large number of greases will be needed. Experience has shown, however, that a few basic types can be made to do the work quite satisfactorily. There are few plants in the country containing more varied types of machinery than the Schenectady Works of the General Electric Co. Twenty years ago, more than 35 varieties of greases were in use there, but since then the number has been reduced to a fraction of that.

A list of the greases considered essential for the average plant would include a motor ball and roller bearing grease, a cup grease and a grease for pressure lubricator or one shot systems. Other greases which might be desirable are a high temperature grease, a waterproof grease and possibly one or two graphite greases. For special applications a low temperature grease might be added. The chart shows the properties that might be expected from the various greases.

The main uses for a cup grease will be for greasing sildes, machine ways and filling cups on various pieces of machinery in which ball or roller bearings are not involved. For this a grease with a 300 second viscosity oil rather than one made with 100 second viscosity is probably the best. However, for the purposes for which an ordinary cup grease is used, the grease with the lower viscosity oil will probably be satisfactory.

A large portion of the bigger machinery in the average plant such as punch presses, lathes, boring mills, etc., is probably equipped with pressure-lubricator or one-shot systems.

The grease used for this purpose should be soft enough to be forced through long lines easily and the oil and soap should not separate under pressure or under a moderate amount of heat, in case the supply lines should pass through some warm spots. To overcome the tendency to bleed oil, which is prevalent in greases of lighter consistencies made with low viscosity oils, a grease containing an oil with a viscosity of 500 to 800 seconds at 100 F is desirable.

The selection of ball and roller bearing grease must be done more carefully, especially if the apparatus involved includes some machinery, such as motors, which may be operating under decidedly adverse conditions. It has been said that for 95 per cent of all the applications, an ordinary grade of ball and roller bearing grease would probably be satisfactory. But, as there is bound to be some apparatus hard to lubricate, it is better to have the type of grease that will meet all conditions.

Therefore although a calcium soap base ball bearing grease might be used, under some conditions, a sodium or sodium-calcium base grease is preferable. It should be capable of standing a temperature of 175 F for continuous operation in motor bearings or other equipment for 24-hours, seven-days operation or of 200 F for intermittent operation without undue bleeding, hardening or oxidation.

On the low side, it should stand temperatures down to -25 to -30 F as some of the equipment may be exposed to these temperatures during winter in outdoor installations. It should be soft enough in a consistency to be applied without too much exertion through a hand-operated grease gun, but not so soft that it will leak and not stay in place. In cases where the temperatures of pressure lubricator systems are over 150 F and for which the calcium soap greases are not suitable, the grease should be capable of being pumped through long lines without undue effort.

There are always a few pieces of apparatus or machinery which will need a high-temperature grease. These include motors over drying ovens, bearings on the rollers of heat-treating furnaces, conveyor chains passing through ovens, car bearings on cars pushed into ovens or furnaces, etc. If the temperature in the bearings is not over 230 F, there are several high-temperature greases available.

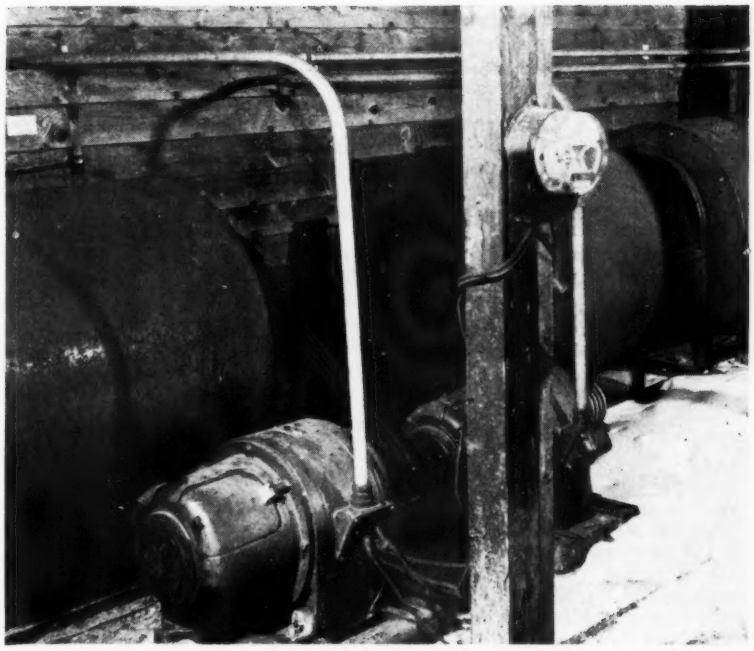
Occasionally, special greases are needed that will stand quite high temperatures which may approach 350 to 400 F, or even 500 F or above. Greases made from petroleum oils are not usable at these temperatures. The products holding the most promise are the silicone greases, some of which have stood temperatures up to 400 F for several hundred hours. These greases are very expensive, but there are times when cost is no object if the equipment will perform satisfactorily.

If the apparatus, subjected to high temperatures of the 230 F range, is running at speeds below 5000 rpm, a grease of about 240 to 270 F consistency is desirable. If speeds above 5000 rpm are encountered, a stiffer grease of about 200 to 240 consistency will probably give better service.

Waterproof grease is not a large item, but there are often one or more

The table below shows suggested properties of various greases suitable for general plant use

Type of Grease	Consistency as Received	Worked Consistency	Soap Base	Water Soluble	Safe Oper. Contin.	Range Intermit.	S.U.V. of Oil 100 F
Motor, Ball and roller bearing	260-290	270-290	Na-Ca or Na	Yes	175 to -30 F	200 to -25 F	250-400
Cup	215-245	225-255	Ca	No	150 to -30 F	175 to -25 F	300
Pressure lubricator	310-340	320-350	Ca	No	150 to -30 F	175 to -25 F	500-800
Silicone grease	200-230	220-250	Li	No	400 to -30 F	425 to -20 F	300 or higher
High Temperature	230-260	240-270	Na	Yes	210 to -10 F	230 to 0 F	300 or higher
Waterproof	280-310	300-330	Zn	No	140 to -30 F	160 to -25 F	over 250
Low Temperature	250-320	270-320	Li	No	160 to -67 F	170 to -60 F	60-80
No. 2 Graphite	250-280	265-295	Ca	No	150 to -30 F	175 to -25 F	200-300
Semi-fluid Graphite Grease	—	—	Na	Yes	175 to -30 F	200 to -25 F	Over 500



Machinery which is required to operate under extremes of conditions, as are these motors, must have carefully selected greases if they are to function properly

applications, such as for the sliding surfaces on hydraulic rams. Occasionally, there is a use for a grease to resist solvents, for vapor degreasers, etc., such greases are available. Graphite greases are used in many large plants, and in some cases are coated on the teeth of crane gears and are said to enable the gears to stand higher loads. A semi-fluid graphite grease is useful for greasing the slides on elevator shafts. A real low temperature is very rarely required, but if needed is available.

The method of application of greases will depend upon the type and make of equipment to be lubricated. Some makes of motors, for instance, have pressure fittings on them for re-lubrication, including both filler and relief plugs. Others have only filler plugs, and some have no means of refilling without removing the bearing caps. A few are supposedly lubricated for the life of the apparatus.

The larger pieces of equipment, such as punch presses, etc., have the one-shot or pressure lubricator systems. When lubricating apparatus equipped with pressure fittings and relief plugs, the relief plugs should be removed and the hole cleaned of hardened grease before refilling the bearing. If the pressure relief system is used, new grease is pumped in through one of the standard fittings, using a hand or power operated gun with the motor running at operating temperature until new grease comes out the relief hole. The relief plug is left out until all the excess grease is expelled, before being replaced.

Apparatus with only a filler plug and no relief plug must be relubricated more cautiously to avoid overfilling of the bearing. Older types of motors which have no fittings at all must be refilled by removing the bearing caps and repacking by hand to ⅓ to ½ capacity. If the machinery in a plant is badly worn, much heavier grades of greases than those shown in the chart may be needed to prevent severe leakage.

The average load conditions encountered should give no trouble if good standard grades of greases are used. There are extreme pressure greases on the market, but they are not needed except for special cases such as steel mills, paper mills, etc., where the loads are very heavy.

How often should factory machinery be greased? This is a problem the user has to face, and very little guidance is given him by the manufacturer of machine tools, who usually says to grease as often as is found necessary. The average plant has its machinery greased much oftener than is needed, probably to be on the safe side.

In general, more troubles have come from over-greasing bearings than from lack of lubrication. Some factories make a practice of regreasing a large part of their apparatus once a week, others prolong their regreasing periods to two years or more. In some cases the latter escape bearing failures, but many times they are not so fortunate.

One large manufacturer with many sizes of motors running in such locations that relubrication at frequent intervals is not practical, bases his frequency of lubrication on the running ft. per minute of the bearings. This is calculated as follows:

Circumference of bearing × rpm = surface feet. Diameter is figured as the distance across the bearing from center to center of the balls. All speeds under 2000 surface feet per minute are not considered critical, and such motors are examined once a year if the rpm is not over 1800. At higher rpm, such as 3600 or over, the bearings are examined every two weeks.

The range of temperature of the bearing grease in these cases was 30 to 150 F. The Bureau of Ships has a general policy that bearings shall be relubricated every three months.

A general statement might be made that if a plant has only small size motors not over 15 hp, running at 1800 rpm or less, a safe practice would be to relubricate them once every six months. It is entirely possible that they might run for a year or more without relubrication and not give any trouble. This is assuming that the temperature of the grease in the bearings will not exceed 150 F.

Most motors actually run much cooler than that, nearer 110 to 120 F. If there are any 3600 rpm motors present, they should be examined every month, even if no grease needs to be added. If the ambient temperature is higher than 100 F, and the bearing temperatures should go above 175 F, it would be wise to examine them every two weeks. Where large motors of 100 hp or more, running at various speeds, are among the plant equipment, a monthly examination is also desirable.

If the rpm of these motors is only 600 to 900, some greases may become softened and leak out in a short time. Large size bearings running at 3600 rpm or over are especially hard to lubricate well, and if high temperatures are involved as well, it becomes a real problem to keep the apparatus running without encountering trouble. More frequent inspections at two week intervals are desirable for these applications.

If apparatus is operated under very dusty or dirty conditions, it may be necessary to relubricate frequently, making sure to avoid too much grease. Sometimes a heavier grease will aid in sealing out the dirt.

It is wise to clean out the bearings and repack them with new grease every time a motor is down for other repairs. Even if everything is running all right the old grease in a motor should be cleaned out of the bearings at least once every three or four years and replaced with new grease, as most greases will have become quite oxi-

(Continued on page 21)

Electrical Contacts

Some Problems Connected With Their Use

Most electrical contact trouble can be traced to excessive overloads or corrosive atmospheres . . . Classification of contact failures in six major groups . . . Failure to open caused by overloads or welding . . . Excessive arcing and methods of quenching . . . Use of inserts on make and break points . . . Overheating of contacts . . . When and when not to re-surface contacts . . . Transfer of contact material . . . Formations of craters and build-up . . . Routine maintenance for care of contacts

By V. E. HEIL
Metallurgical Research Dept., P. R. Mallory & Co., Inc.

SUCCESSFUL OPERATION of innumerable types of electrical switching equipment, varying from small sensitive relays to large power circuit breakers, depend upon the reliable operation of electrical contacts.

For this wide range of applications, there are a large number of available contact materials consisting of pure metals, alloys, and mixtures or metals made by powder metallurgical methods. The more common contact materials and some of their typical applications are listed in the accompanying table.

In most cases switching equipment is well designed and will give long periods of trouble-free operation when properly used. In cases where they give an unsual amount of trouble, unreliable operation can usually be traced to excessive overloads or the fact that they are in locations where the atmosphere is very corrosive.

Practically all of the contact failures can be described by one of the following classifications.

1. Contacts fail to open the circuit.
7. Excessive arcing at the contacts.
3. Excessive wear or erosion of the contact material.
4. Contacts overheated while carrying current.
5. Contacts failed to pass current when closed.
6. Excessive transfer of metal from one contact to the other forming a build-up.

Failure To Open: When the circuit phenomena calls for the contacts to open the circuit and they fail to do so, the failure is usually caused by the contacts welding closed. Many cases of contact welding may be attributed to the fact that the switching device had been handling electrical loads which were considerably above its rating.

For example, a switch rated at 10 amp may fail due to the welding of the contacts on a 10 amp lamp load because the inrush current on this load would be approximately 11 times the steady state current. This is 110 amp and a heavier switch or one designed especially for lamp loads would be indicated. The current for starting a motor is about six times the full load current of the motor. An ample safety factor must be built into the motor starters to prevent contact welding due to the inrush currents.

Welding of the contacts may be caused by misadjustments in the switch. A weak contact spring may allow the contacts to bounce excessively when closing the circuit. Abnormal arcing during the period that the contacts are bouncing may cause the contacts to weld. In most electrically operated switches, there is an additional movement of the armature or solenoid plunger after the contacts close. This movement is called *over-travel* and usually is used to compress a spring which applies the force that holds the contacts closed.

During the opening sequence, an impact force may be applied to the moving contact as a result of this over-travel to aid in the opening of the contacts. If, because of misadjustment of the switch or excessive wear of the contacts, the over-travel is insufficient, the contacts may not open.

There have been cases where faulty operation of control contacts have caused switches to chatter excessively during their closing and opening operations. Excessive arcing during the period of chatter has caused switch contacts to wear excessively and to weld closed.

In some cases where contacts fail to open it will be found that they are held together mechanically by a build-up of contact material on one contact interlocking with the crater in the other contact. This type of failure is more prevalent in d-c circuits where pitting and transfer are more common.

Transfer sometimes can be reduced or eliminated by changing to a new contact material. In other cases it may be necessary to alter circuit constants, or insert a polarity reversing switch to periodically reverse the flow of current through the contacts.

Excessive Arcing: Arcing is excessive when it prevents a satisfactory interruption of the current, or causes the contact material to wear at an excessive rate, causes excessive oxidation of the contact surfaces, overheating of contacts, or an excessive rate of transfer of the contact material. In power switch gear it is not possible to operate without arcing, however, arcs should be extinguished as soon as possible.

In a-c switch gear the arc is extinguished every time the current passes through a current zero, and in the design of the switch gear steps are usually taken to de-ionize the gap between the contacts to prevent re-ignition of the arc in successive half-cycles. The d-c arc has no self-extinguishing feature such as a current zero and must be extinguished by lengthening the arc and cooling it until it requires a voltage greater than the circuit voltage to maintain it.

A popular method of de-ionizing arc gaps is to break them up into a series of gaps by either de-ion arc chambers or a multiplicity of contacts connected in series. Arcs are lengthened by such features as air blasts and magnetic blow-outs. Special arc extinction features are incorporated into the design of certain switch gear and are not simply added as auxiliary equipment.

In switching less powerful inductive circuits, the energy released by the inductance when the contacts open causes heavy arcing at the contacts and their rapid deterioration. In many cases, the arcing can be eliminated or reduced to a tolerable value by special arc quenching circuits consisting of resistors or condensers or combinations of the two across the contacts or the inductance. The optimum values of the compo-

nents of the quench circuits can best be determined by tests under actual operating conditions.

Abnormal wear of contacts may, in some cases, be due to mechanical conditions, but in most cases, it is caused by arc erosion. Mechanical wear can be reduced by lessening the impact and closing forces and reducing the amount of wiping action.

Arcing heats the surfaces of contacts to very high temperatures and vaporizes metal from the contact surfaces. Part of the metal vapors redeposit on the contacts. However, some of the vapors are lost in space and, as a result, the contacts wear away. Frequently, by increasing the area of the contacts their life may be extended to a reasonable value.

Under conditions of heavy arcing, sizable portions on the contact faces become molten and particles of metal are blasted into space by the large forces that exist at the contact faces due to arcing. When this condition exists with copper or silver contacts, their wear may be so great that they are entirely undependable. In some instances, the performance of the switch may be improved by changing to more arc resisting materials.

For example, some contactors show improvement under these conditions by substituting a silver-cad-

COMMONLY USED CONTACT MATERIALS, TYPICAL APPLICATIONS, AND OPERATING CONDITIONS

Contact Materials	Typical Applications	Conditions
Platinum **Platinum-Iridium** **Platinum-Ruthenium**	Sensitive relays and instruments, thermostats.	Current and voltage small, very light forces, freedom from insulating surface films.
	Magnetos (alternating polarity type)	Positive operation at slow speeds. Freedom from corrosion. Must be protected from oil and oil vapors.
Palladium **Palladium-Silver** **Palladium-Copper**	Telephone and light duty relays, thermostatic controls.	Good wear resistance and resistance to transfer at low currents and dc voltages of 24 to 60 v. Good tarnish resistance.
	Potentiometer contacts.	Where contacts slide on nickel-chrome windings and handle low currents.
Fine Silver **Silver-Copper** **Silver-Cadmium** **Silver-Palladium**	Industrial relays and controls, motor starting winding switches, domestic switches, limit switches.	Moderate currents on industrial and domestic voltages, rapid make and break.
	Thermostats	Moderate currents and a-c voltages, slow make and break.
	Automotive switches, relays, and control devices.	Battery voltages and moderate currents. Silver alloys often preferred to control metal transfer.
Tungsten	Automotive ignition systems, horns, magnetos (unidirectional current), electric fence chargers.	Battery voltages, inductive circuits. Resistance to arcing and metal transfer.
	Speed governor contacts, calculating and business machine motors. Electric razor contacts.	Domestic voltages low currents, very rapid operation. Resistance to wear and metal transfer important.
Silver-Cadmium Oxide	Heavy duty motor starting switches and industrial relays. Main current carrying contacts for multi-stage circuit breakers.	Heavy currents at industrial voltages. Greater resistance to arcing and welding than silver. Low contact resistance.
	Heavy duty aircraft relays. Low voltage, heavy duty contactors.	Very heavy currents in low voltage d-c circuits. Offers low contact resistance and excellent resistance to welding of the contacts.
Silver-Nickel	Main current carrying contacts for multi-stage circuit breakers.	Maintain low contact resistance and temperature rise.
Tungsten-Silver **Molybdenum-Silver** **Tungsten Carbide-Silver**	Circuit breakers with no auxiliary arcing contacts.	Must have low contact resistance temperature rise to restrict high temperature rise. Must resist arc erosion on short circuit currents.
	Arcing contacts for heavy duty multi-stage air circuit breakers.	Must resist erosion caused by very heavy arcing but maintain sufficiently low contact resistance to prevent excessive arcing at the main contacts on opening the circuit.
Tungsten-Copper **Tungsten Carbide-Copper**	Oil immersed switches and transformer tap changers.	Must handle heavy currents at high voltages and maintain low contact resistance and resist erosion of the contact material.
	Arcing contacts for oil circuit breakers.	Must resist erosion caused by heavy arcing but maintain sufficiently low contact resistance to prevent excessive arcing at the current carrying contacts.
Copper **Copper-Cadmium**	Industrial contactors.	Heavy currents at industrial voltages. Contacts must be closed under heavy forces to assure low contact resistance.

mium oxide contact material for their original fine silver contacts. Some copper contacts make and break the circuit at one portion of the contact surface and move to a different area for carrying the current. Elkonite, a registered trade mark, inserts covering the area that first makes and last breaks the circuit on these contacts have increased their resistance to arc erosion considerably. Use of inserts and the comparative effectiveness under load arc shown by Figs. 1 and 2.

Elkonite materials are powder metallurgy products wherein high melting point metals, such as molybdenum, tungsten, or tungsten-carbide, are intimately combined with the high conductivity metals, silver or copper, to form a material which has unusual wear resistance under conditions of intense arcing.

Overheating Of Contacts: Heat is generated in an electrical circuit when a current flows through a resistance. All electrical conductors have resistance and there is a certain amount of resistance on any piece of switch gear. The amount of heat generated will vary directly with the resistance, the square of the current, and the length of time that the current flows. The greater amounts of heat will be generated at the points of higher resistance.

A large portion of the contact resistance in switch occurs at the inter-faces of the contacts. The resistance is high at this point because only a small portion of the total area of the contact surfaces are actually in contact. The temperature to which the contacts are heated depends upon the rate at which the heat is generated and the rate at which it is carried away by heat conduction and radiation.

Probably the most frequent cause for overheating of contacts is high contact resistance. High contact resistance is usually caused by non-conducting films on the surface of the contacts, insufficient contact pressure, or the wrong contact material. Non-conducting films are caused by oxidation of the contact material due to heavy arcing or overheating; by atmospheric corrosion caused by prolonged exposure to high temperatures, high humidity and active chemical vapors or gases, and by air-borne dirt.

In some cases it is possible to recondition the contacts by removing the non-connecting film. A clean file is usually one of the better tools for resurfacing contacts. One should be cautioned against grinding or using abrasive papers on soft contact materials like silver and copper because non-conducting abrasive particles are easily embedded in these materials.

One should not hastily condemn contacts because their surfaces appear roughened and discolored. In the majority of the cases, such contacts will still have a low contact resistance and more harm than good will be done by resurfacing them. Abnormal voltage drops across contacts or high contact temperature rises while carrying rated current or less may be indications of non-conducting films on the contact surfaces.

On the other hand, they may be indications of insufficient forces holding the contacts closed, or loose or high resistance connections elsewhere in the load circuit of the switch. A careful diagnosis is important. In a number of cases, excessive contact temperatures have been caused by switches carrying currents which are well above their rating.

Contacts have been known to overheat in air circuit breakers which have been closed and conducting currents for long periods of time, sometimes measured in months or years. These troubles have been traced to atmospheres. Such cases could be minimized by simply manually operating the breakers intentionally under load. If this were done at intervals of 6 to 10 wk, the arcing at the contacts would help to keep the surface clean and minimize contact heating.

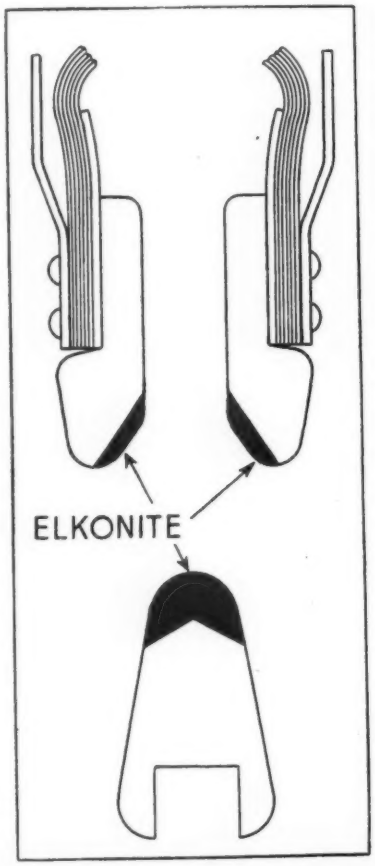


Fig. 1. A typical design of finger and wedge type oil circuit breaker contacts showing the method of applying inserts

Arcing at the contacts is another source of contact heating, and the rate at which heat is generated is a function of the intensity of arcing and the number of times that the contacts operate in a given period. If the contacts operate frequently, such as in a vibrator or a regulator, the heating due to arcing may be appreciable even though the energy of any one arc may be low. Heavier contacts and heavier backing members will help to carry the heat away from the contact surfaces faster and hold the contact temperatures to a lower value in these instances.

Contacts Fail To Pass Current: Where contacts close and fail to pass current, the cause is usually badly oxidized or corroded contacts, or excessive contact wear which has progressed to the point where the contact surfaces fail to touch when the contacts are in the closed position. When these conditions exist, a volt-meter connected across the points will indicate a very high voltage or it may even measure full circuit voltage.

When the fault is due to excessive oxidation or corrosion, the surfaces of the contacts have reached a state of extremely high contact resistance and the causes again have been excessive arcing or very corrosive or dirty atmospheres. Such contacts should be resurfaced or replaced.

All contact materials do not form high resistance oxides under heavy arcing conditions. Instead, they may wear away at an excessive rate. Usually when the wear is excessive, the switch is too small for the application or the wrong type of switch has been used.

When a switch is closed and current does not flow, in many cases the failure is at some point other than at the switch. There may be an open circuit in the circuit or in the lead. A fuse may have blown or a circuit breaker may have opened.

Transfer Of Contact Material: Transfer is a migration of contact material from one contact to the other. It leaves a crater in one contact and produces a build-up of contact material on the face of the mating contact. The phenomena which causes transfer is related to the polarity of the voltage applied to the circuit in which the switch operates, therefore, it occurs most commonly in d-c circuits and rarely in a-c circuits.

There are different phenomena which contribute to the formation or metal transfer, and the direction of transfer may be either to the positive contact or to the negative contact depending on which phenomenon is the controlling factor. Every time contacts make and break a current, there is a tendency to transfer metal to the negative contact, and the rate of transfer increases with increasing currents.

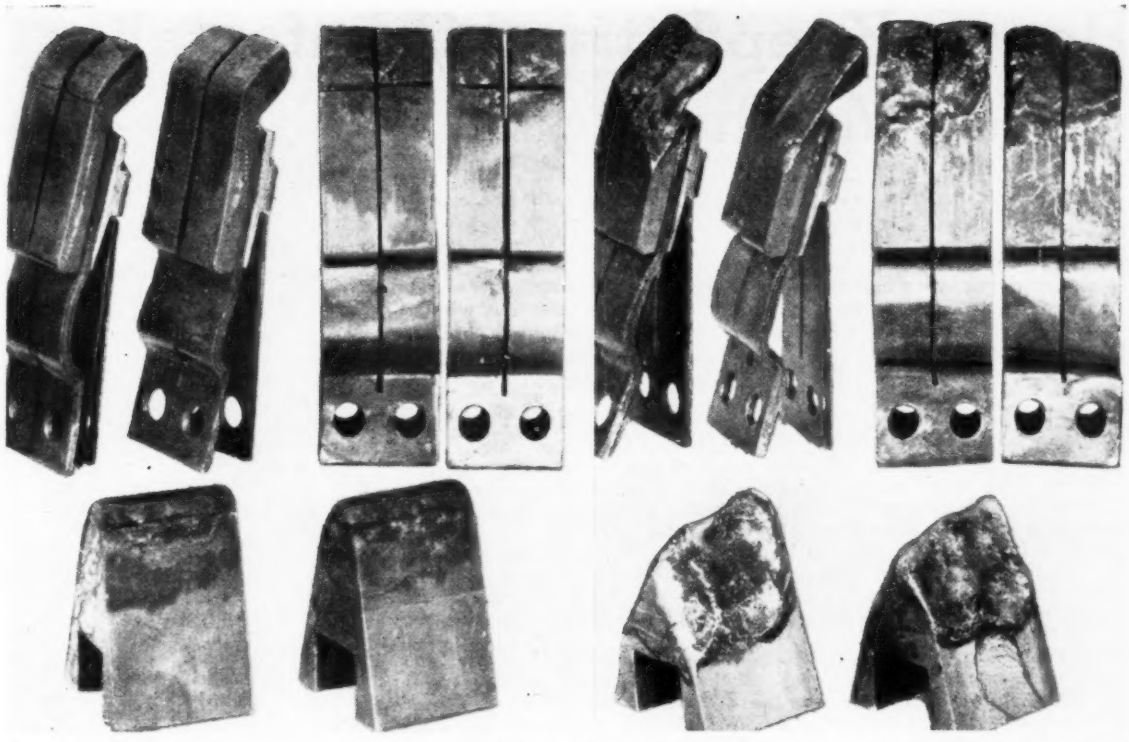


Fig. 2 A comparison of the damage sustained by copper (left) and Elkonite (right). Arcing contacts of the finger and wedge type after exactly similar short circuits

When contacts arc on opening the circuit, due either to high circuit voltages or high inductances in the circuit, there is a tendency to transfer metal to the positive contact. If the latter phenomenon is of greater influence than the former, the resultant transfer will be to the positive contact.

Excessive transfer may lead to failures of different forms. In some cases the build-up may interlock with the crater and the contacts will hang closed mechanically. In some cases the configuration of the build-up differs from that of the crater and the build-up interferes with the closing of the contacts.

This sometimes happens in the vibratory systems in control devices and it changes the calibration of the device. Some failures are due to the fact that the crater completely penerates the contact facing material and the contacts become high resistance because the arc then attacks the backing material whose oxides are non-conducting.

Transfer can be controlled to a large extent by varying circuit constants. Especially where arcing causes excessive positive transfer, the arcing and transfer may be reduced by such arc suppression circuits as condensers or resistors, or combinations of the two across the contacts, or the inductance in the circuit, or both.

Sometimes it is possible to change from excessive positive transfer to excessive negative transfer by making too drastic a change in the circuit. Frequently, a condition of a slight amount of arcing is beneficial in limiting the amount of negative transfer that may occur if the arc is entirely eliminated. In some cases it may be desirable to change to a different contact material to improve transfer tendencies.

Such measures as circuit changes or changing contact materials can be somewhat critical and it may be advisable to consult with switch manufacturers or manufacturers of contact materials before making such changes.

Summary

In the course of routine maintenance of switch gear, the contacts should not be resurfaced just because they appear somewhat roughened and discolored. More harm than good may result from such practice. Contacts should be resurfaced only when there are definite indications that their surface condition is contributing to the faulty operation of the device.

If a contact making device requires frequent attention, the switch mechanism, such as bolted and riveted electrical connections, springs, adjustments, etc., should be checked. When a device has given trouble ever since its installation, a different type of switch or one of a higher rating may be needed. In some instances, the performance might be improved by changing contact materials. It is strongly recommended that a manufacturer of contact materials or switches be consulted before making such changes.

Selection of Greases

(Continued from page 17)

dized and sticky and gummy during that period of time.

The use of greases containing anti-oxidants will of course retard the formation of these undesirable compounds. Indications of a badly oxidized grease are a noticeably rancid odor, usually accompanied by a darkening of color to a reddish brown. This change is observable mainly in the light-colored greases and would not be noticed in a dark brown or black grease.

Laboratory checks for free acid content and dropping point can be readily made on both the new and used grease. A badly oxidized grease will have a free acid content of from 3 to 5 per cent, and its dropping point may be 40 to 50 C or more below what it was in a fresh unused sample of the same grease. There are many good, stable ball and roller bearing greases available on the market today.

A carefully planned program of lubrication will well repay the plant management of any factory and will aid considerably in lengthening the life of plant machinery.

How to Keep Fit and Comfortable in Hot Weather

By ERNEST A. DENCH

Comfort and efficiency in hot weather depends upon clothing, diet and environment . . . Care of the body and clothing . . . How and what to eat . . . Use of salt or salt and glucose to reduce heat prostration . . . Window shades, their use and effectiveness . . . Rest room facilities and overall plant cleanliness . . . Electrical accidents in the plant

FIRST COMES the worker himself, second is the on-the-job environment. The most the employer can do is to suggest how the employee can properly take care of himself in hot weather. The available media consists of bulletin boards, timely reminders in pay envelopes, and informal talks in departments.

The solution to the second problem is in the hands of the employer and his administrative associates. A comfortable working environment is assured by careful and constant attention to ventilation, shading the windows from direct sunlight and an immaculate working area.

When the climate is most trying, it will take money, time, and effort to bring about conditions approaching the ideal. Benefits to the employer will include a reduction in hot weather absenteeism from good cause for fit workers will *remain* fit longer each day so production should be sustained at the normal year-round capacity.

Care of Worker's Body: Not all heat illness is derived from the strain of working. Sometimes a contributing cause is carelessness in his use of leisure and sleeping hours. One August, following a month of oppressive weather, the New Jersey Bureau of Industrial Health became alarmed at the abnormal rise in industrial heat sicknesses within the state and came out with a list of timely recommendations. These included a minimum of 8 hr in bed, frequent baths and showers, clean, light-weight clothing, mild forms (not too energetic) of sport and exercise to keep sweat down to a minimum, and open (but screened) windows in the home.

The worker who dresses *right* can endure high temperatures better than the worker who dresses *wrong*. The right way is to work in a shirt or undershirt. The wrong way is to discard every strip of clothing above the waist. The explanation is that the body is cooled by moisture evaporation from sweat-saturated clothing.

Some workers suffer from skin irritation when they expose too much of their bodies to direct sunlight. It attacks the arms when the sleeves are rolled up all the way, or when the garment is sleeveless. Wool is preferable to cotton, since it readily absorbs moisture, and prevents colds. Head coverage is best with a broad-rimmed hat of some type.

Another cause, one not often suspected, of summer sickness on the job, is footwear. Instead of wearing the same pair of shoes each working day, one should have two pairs to wear on alternate days. The perspiration thus has a chance to dry out. It is also good shoe leather insurance, since each pair will last longer without cracking.

Eating and Drinking: Much of the advice as to what to eat and drink in hot weather is to "go light." In occupations requiring considerable physical activity, this advice is harmful, contends Dr. A. R. Smith of the New York State Department of Labor. Such male and female workers still need their three heavy meals a day. The only climatic concession is that the meals should be heavy not only in bulk, but in Vitamin C content. The latter is derived from salads, fruits, and fruit juices. Milk is also a good pick-up.

If it is noticed among workers that the hot weather trend is to eat and drink oftener in smaller amounts rather than consume regular meals of normal bulk, there should be pick-up or snack sessions to ensure the full intake the body needs.

Working under excessively hot or humid conditions caused by manufacturing processes rather than the outside temperature, is doubly exhausting. Any hard physical labor of this type rapidly burns up the sugar in the human body. In one plant the foreman had the trick of keeping up the output by periodically passing around a bag of gum drops. Access to cool but not cold drinking water is also a help. Water registering a temperature of 50 F is ideal.

Sweat and Salt: In a 1943 study of 437 cases of industrial heat diseases, it developed that the majority had failed to take the required daily amount of salt. The minority who had faithfully followed the prescribed salt-taking directions issued by the management had approximately half the amount of sickness as the neglectful majority.

Over a period of three summers, one firm had 10 per cent of heat fatigue and heat exhaustion cases. Two of the men died. No salt was available in any form to the working force during regular shifts, except what the men took in their food during meal times. Three summers later, following the introduction of salt-dextrose tablets, the ill effects of heat were reduced to four per cent.

Dr. John P. Russell, chief of Industrial Hygiene Services, California State Department of Health, has defined sweat as a dilute liquid containing from 0.1 to 0.5 per cent sodium chloride. Unless this sodium chloride in the body is replaced, heat sickness in some form or another is bound to occur. Either salt or salt tablets will furnish this sodium chloride. Further assistance can be rendered by eating and drinking the right foods. For example, there is 0.3 per cent of sodium chloride in milk. Meat also contains it.

Workers prone to perspire freely are inclined to drink more water than is good for their systems. This causes cramps. Especially is this the case if their work is in the vicinity of furnaces or other hot or humid places in the plant. The remedy is a salt tablet dissolved in each glass of water. Equally satitsfactory is common salt, a dosage of from one-quarter to one per cent in each glass of water. From three to four dosages during an 8 hr shift are sufficient in normal cases.

Cases of heat fatigue and exhaustion are more common among new, inexperienced workers. It is because the human body has to have time to allow for the adjustment to a different working environment. That's why, at first, a man on hot, heavy work will not sweat like a veteran. A few days later the heat regulating mechanism of his body will be churning up the sweat the way it should.

Two types of salt tablets are available. One is the size of an Aspirin tablet, containing 10 gr of salt. The dosage should vary with the worker's occupation: light physical activity, four to five tablets daily; medium manual labor, eight to 12 tablets: a heavy, hot job, 12 to 15 tablets. By a day is meant an 8 hr shift. The other type of salt tablet has seventy per cent salt and thirty per cent glucose. It is claimed that this in-

creased caloric content produces a pick-up reaction.

Going back to the first type of salt tablet, its advantage over ordinary table salt is that it does not affect the taste of the water. On the other hand, some men engaged on strenuous physical work report that ordinary salt-flavored water is quite palatable and refreshing. The greatest satisfaction from ordinary table salt in drinking water is to have some reliable person pre-salt the cooler. One teaspoonful to the gallon is the right proportion. The risk in letting workers salt each glass as needed is that they will forget directions and douse the water too heavy with salt so naturally it will not be palatable. (See PLANT ENGINEERING, Feb. 1948, page 29).

Some of the employees of one firm complained that salt tablets from the dispensing machine near the drinking fountains caused nausea. When the matter was investigated, it was discovered that the workers were swallowing the salt tablets like candy—and without benefit of water.

Window Shades: Uncovered factory windows are fully exposed to the sun, the light and heat transmitted may total 85 per cent. The object, therefore, of some protective window covering, either inside or out, is to decrease the light and heat transmission.

An outside covering is considerably more effective than an inside covering. The canvas awning painted in aluminum ensures a reduction in the light and heat transmitted, from 85 to 22 per cent. Trailing behind, by six per cent (or 28 per cent of light and heat transmitted), is the plain canvas awning. Certain types of screening is also very effective in reducing heat absorption without a corresponding decrease in light.

Now for the inside coverings. The ordinary roller shade, if fully drawn, accomplishes a reduction from 25 to 45 per cent of light and heat transmitted. The venetian blind is second, in reducing the light and heat transmitted from 25 to 58 per cent.

Ventilation: Foul air can be converted into fresh air by fans working in conjunction with radiators or other cooling devices, such methods are an improvement over ordinary portable electric fans.

One method recommended by Dr. Adelaide Ross Smith of the New York State Department of Labor, is particularly applicable to working quarters where the air is constantly overheated, causing uncomfortable perspiration. The method is a blast of air directed over the workers, or cooler air introduced inside a loose-fitting coverall suit. This might be supplemented, suggests Dr. Smith, by recesses during the day of batches of employees remaining in a cool-off room for a few minutes, and also by shower facilities at the end of the day's working shift.

Rest-room Facilities: Even with proper care, the rest-room or washroom is not free from odors. In the hot weather they are more potent and obnoxious. The underlying cause is insufficient ventilation. The place should be given a thorough airing every morning before the workers arrive by opening all doors and windows (screening them against insects).

The musty odor so common in washrooms in the basement is impossible to remove if the floor surface is wood over earth. This musty odor has a tendency to rise and penetrate some of the upper floors of the plant. One industrialist had the basement floor cemented, and the musty odor gradually disappeared.

Other causes of washroom odors include the floor surface not being cleaned often enough. Another is too infrequent washing down of urinals, and all exposed surfaces of wash basins, etc.

Dull painted surfaces radiate gloom because of the dirt and other foreign substances adhering to them. If a washing will not do the trick, they should be repainted in a light and cheery color.

The Plant as a Whole: One industrialist is of the firm conviction that good housekeeping does not need over-touted clean-up weeks once a year. The psychology is all wrong, he says, since they encourage both management and men to be untidy and neglectful the remaining 51 weeks in the year. This neglectfulness is conspicuously acute during the hot weather, when any unnecessary chore is postponed until later on. The more untidiness exists, the more time and energy is needed to dispose of it, whereas if the management insists on cleanliness as a daily routine, there will be no accumulation to catch up with in the plant.

Electrical Accidents: Summer produces an increase in plant accidents. Perspiring hands and fingers introduce wet contacts, causing tools to slip. There are also seasonal hazards from electrical appliances or electrical connections. The normal safeguard of rubber gloves, because they are clammy to wear, is likely to be omitted by the thoughtless or careless type of worker.

"I don't give a hoot if you can work that way—turn around and work right!"

Heavy Rigging in the Plant

This first of two articles covers the typical equipment available for heavy lifting inside and outside the plant . . . Types of hitches and precautions to follow in the use of wire rope, hemp rope and chain are presented . . . Special equipment for various work described

By H. B. McDERMID

ELECTRIC motor-powered cranes perhaps are the most common of all cranes. The standard overhead machine of this type came into use shortly after the first electric motors became feasible units for driving them. They are produced in sizes and capacities from 500 lb up to approximately 650 t capacity. A navy unit of this size has a runway 730 ft long at a height of 182 ft, and can handle a lift at least 100 t greater than any other known crane.

Units of 250 t capacity are rather commonplace where the size of the work justifies them, as in many railroad shops where they regularly handle huge locomotives. Such cranes are found in our heavy steel mills and in other heavy industrial works. One is shown in Fig. 1. Here the boiler and upper parts of a huge Mallet articulated locomotive in a western shop in California are being placed on the trucks.

The larger overhead cranes commonly travel on tracks attached close to the walls of the room or the limits of the yard they serve. In some locations the tracks are at the working level or shop floor and a tower at each end of the bridge is used to support the crane at the proper height. These are called gantry cranes and in some types of construction work are installed over large buildings, straddling the entire area. They may be used on dam construction in which case the upper framework usually projects well over the forward legs, cantilever fashion, so the concrete forms can be placed ahead and filled while the crane is supported on concrete that has been aged enough to bear the load. Figure 2 shows two such cranes serving a building site where work eventually grew to about 1000 ft long by 200 wide by 150 ft high. Here the cranes (there are four) served not only the building, but the cantilevers also served the railroad line which brought in the necessary material. One of the heaviest cranes of this sort is the one which was used on the Ariel hydro-electric project in California. Its hook is said to be the heaviest ever placed, with a capacity of 350 t. Such heavy units usually depend upon some means other than a hook for their load suspension, such as an eye attached to the main block, with the load attached to it by some special apparatus.

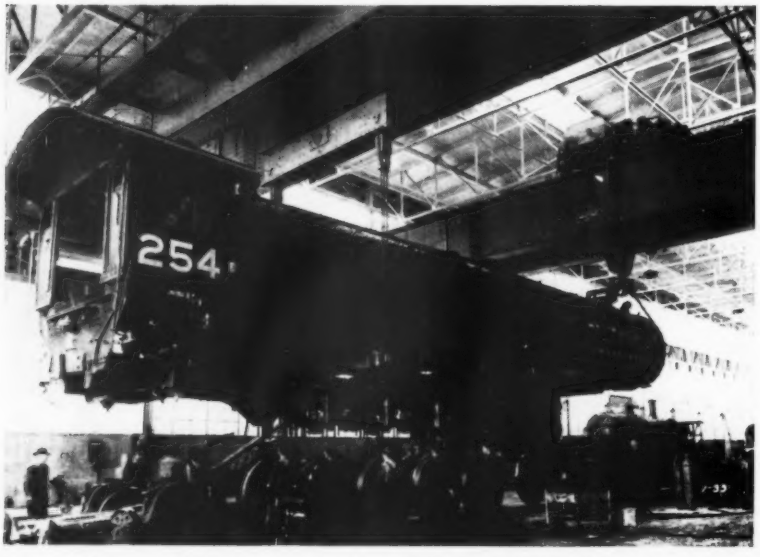


Fig. 1. This crane of 250 t capacity is shown lifting an articulated locomotive on to its trucks in a California railroad shop

Gantry Cranes

Often the gantry cranes are used over outdoor yards, where no building or other form of support is present at a proper height, so the towers at each end of the bridge become the most economical solution to the problem. One is installed over a huge ore storage bin at a steel mill in Youngstown, Ohio. It spans a bin 1000 ft long by 300 ft wide, can pile ore 150 ft high for use during the winter months when traffic from the Mesabi range over the Great Lakes is cut off by ice. Its trolley is rigged for handling huge clamshell buckets for distributing ore into and out of the bin as may be necessary. It can, of course, travel on rails the full length of the bin as can the car dumper shown in Fig. 3. This machine can dump a 100 t gondola freight car every two minutes. A grown-up relative, said to have been installed at Newport News for the navy, back in the days when they still used coal for the big battle wagons, was long enough to handle two such cars at once.

Crane Installation

In some unusual cases, cranes have been installed with one end supported on a high rail and a gantry tower and low rail at the other.

They look odd, but operate much like the usual cranes. One like this is installed in a large shop in Milwuakee, while another is in a frog and switch shop in Cincinnati. Probably the reason for the odd construction was that one wall support for the high rail already existed, and none was in place to support the other end, so the gantry tower was used for economic reasons.

Assuming the crane already exists, the question of rigging to attach the hoisting hook to the load becomes of prime importance. One large firm used nothing but hemp rope in all its machine and erecting shop operations, in sizes of rope ranging from ¾ in to 4 in diameter. As they fre-

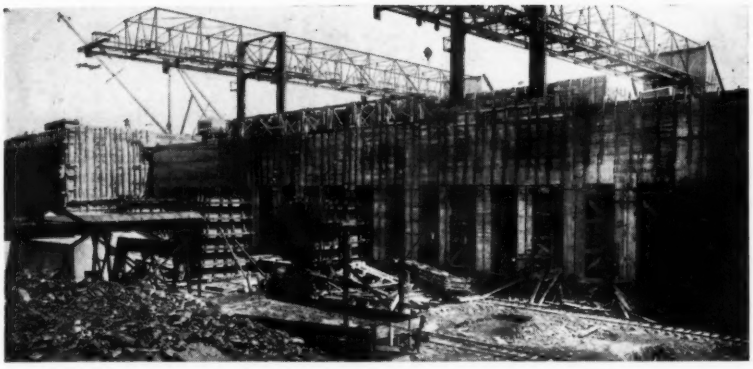


Fig. 2. Two gantry cranes in position over a large concrete construction project where they served not only the constructors but also the railroad line which brought in the equipment for construction

quently built world's record sizes of various generating units up to 1600 t weight, their example certainly looks like a safe bet to follow. Usually their rope was made up into "short splice" slings, and was applied in "choke" hitches, or else both ends of the loops laid over the hook, and the load held securely by the hitch drawing tight upon the width of it. The loops were spread as widely as practical on each side of the center of the weight. Either of these methods ordinarily gave stability enough for safe handling. On finished surfaces however, it is necessary to protect the hemp rope from cutting

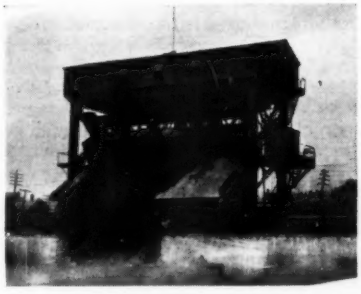


Fig. 3. This car dumper can dump a 100 t gondola car of ore every two minutes

on sharp edges by special means, or by padding the line with heavy burlap bagging or some similar material. In some cases short strips of lumber are used for this protection, but since they are more difficult to keep in place till the strain binds them fast in place, they are not usually looked upon with favor. Where the object is to protect the finished surface, as in the handling of such material as printing press rolls, often belts of clean wide soft leather are used for hitches. These serve their purpose well, where the loads are not excessive. Four inch ropes are used in handling large engine beds which usually weigh 125 t each—some sixty such were handled during this observer's stay in that locality. These required very large slings, and were usually protected at the corners of the beds by special spool-like castings which kept the ropes from being bent too sharply, also from direct cutting by these edges backed by enormous weight. The sketch, Fig. 4, shows the design of these protective castings.

In locations where heat is present, as in foundries where hemp rope would soon burn up to dangerous conditions, chains are usually used for hitches. These should be ample in size for their loads, for they give no warning of impending failure if overloaded but simply snap, and the results are often disastrous.

Use of Chains

Chains should be carefully placed and watched to see that the links are kept straight and free of kinks, which greatly increase the strains placed upon them. Most chain makers give, in their catalogs, tables from which the breaking and safe loads can be found and such lists should be consulted if in doubt. Even if chains are used within their safe limits they will after long use become unsafe through the fatigue of the metal. They then must be annealed by heating to a fair red heat. Then they are placed in air slaked lime or other insulation and allowed to cool very slowly to room temperature. This procedure should be adopted as standard maintenance, at preselected intervals and the practice rigidly followed for the sake of safety. In foundries where the work is large, chains are often employed for the drawing of large patterns. Here special care must be used to get the strains on the pattern equal so the job will "draw" properly without tearing up too much sand on the mold. Often the chains will not be of equal length so the strains are unequal and the molder is forced to "slack off" and shorten his longer chains by inserting nails between the links until the chains pull up equally. A turnbuckle inserted in each chain would serve the purpose better.

Steel Rope

Steel wire rope is used for crane hitches to quite an extent; it has the advantage of being lighter than chains for the same strength, but should be kept as straight as possible when under strain, or it will kink badly.

Sometimes hooks are made fast to the ends of cables used for hitches to facilitate their quicker use, and some special "pennants" are at times made up with eye splices at each end to hook up in special lifts with excellent success. One such example comes to mind: fifteen large stators for a hydroelectric plant with vertical shaft units had to be placed. These lifts had to be handled by two cranes, as they weighed 165 t and were 32 ft in diameter. The points where the hitches could be made were too far apart to handle successfully with one crane. So long pennants of 1¾ in. wire rope were made up and passed through the eye of each main block of the two cranes.

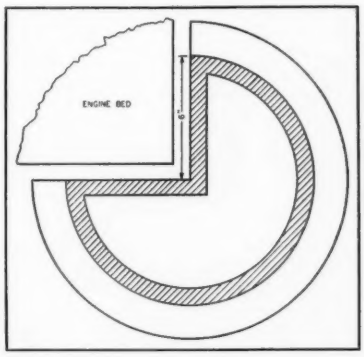


Fig. 4. This sketch shows the construction of corner castings used to protect rope slings used to hoist 125 t engine bed plates. They somewhat resemble huge spools with a quarter-section cut from them lengthwise

Then the four eyes on the ends of the two pennants were made fast to the tops of the stators, with the points of attachment well spread, and the two cranes moved in unison as they set the big rig on its base. As very little kinking was allowed in the cables they could be used over and over. When cable is kinked repeatedly it becomes a terrible mess for the rigger to handle. After the wires begin to break, it gets pretty painful even with heavy leather gloves on the hands for protection. On shafting and such lifts, the finished surfaces must be protected from contact with the wire rope by a veneer of clean sticks of lumber between the wire rope and the shaft surface, or very serious damage will result to the shaft journals.

Practical Machine Installation on Felt Floor Pads

By P. E. KAVANAGH, *Plant Engineer, Chicago Screw Co.**

No bolts or concrete pads . . . Use for any type floor . . . Noise and vibration suppression . . . Methods of installation . . . Desirable loadings in pounds per square inch in different machines . . . Precautions necessary for good service . . . Steel plates for increasing floor load areas . . . Relocating machines . . . Approximate unit cost for felt

FELT IS USED widely and successfully for mounting all types of machines because it offers a quick and inexpensive installation without lag bolts, anchor bolts, or concrete pads. The felt is simply cemented to the floor with a rubber cement which is impervious to oil or grease. The machine is then cemented to the felt.

If the floor is uneven, steel shims may be cemented to the floor and the felt cemented to the shims. If the floor is oil-soaked, it should be cleaned, with any good solvent such as carbon tetrachloride or benzine, before the pad is cemented to the floor. The cement should be permitted to dry 8 to 12 hr before operating the machine.

This type of mounting is very effective in eliminating vibration and noise from practically all types of machines, and is less expensive than the conventional spring type vibration insulator.

Various thicknesses of felt are used, depending upon gross machine weight and the degree of vibration insulation necessary. If used only for installation the following thicknesses and loading pressures are recommended: for machines weighing up to 800 lb, ¼ in. loaded 15 to 20 psi; for machines weighing 800 to 5000 lb, ½ in. felt loaded 50 to 100 psi; for machines weighing over 5000 lb, 1 in. felt loaded approximately 150 psi.

Where vibration insulation is important, the manufacturers offer these thicknesses in different grades to be used at other loading pressures. Thicker pads give more vibration insulation, but may, in some cases, permit too much motion in the machine.

Various felt manufacturers can give recommendations on this point. This is a matter of considerable importance for there is no substitute for their long and varied practical experience with diversified flooring and construction conditions. If the correct material is not utilized in the proper way, vibration absorbtion qualities may not be effective. Again if the correct number of pads of the right size and type are not placed correctly under the machine and in the right location, the performance of the machine may be adversely effected and under extreme conditions may induce stresses which break the machine frame.

Arrangement and size of the pads will depend upon many factors including the type of machine. For example, a punch press weighing 20,000 lb might have a load of 6500 lb on the leg under the flywheel, and 4500 lb on each of the other three legs. Vibration elimination is an important consideration, and a 1 in. thick felt loaded 125 psi might be recommended. This loading pressure would require 52 sq in. under the flywheel leg and 36 sq in. under each of the other three legs.

If the area of the foot on contact with the felt, is large enough to give the desired loading pressure, it may be cemented directly to the felt. If the foot is too small, a ⅜ or ½ in. steel plate of the desired area can be bolted directly to the foot. The felt should be cut to extend approximately ½ in outside of the plate on all sides. If the foot area is larger than necessary, the felt is cut to the

(Continued on page 41)

Photo by The Felters Co.

Fig. 3. As used under a heavy cutter grinder on a wood floor of the Berger Manufacturing Co. Note the flexible vacuum hose for dust removal in the upper right hand corner

Photo by The Felters Co.

Fig. 1. Installation under Bliss 30 ton presses on wood flooring at the Styberg Engineering Co.

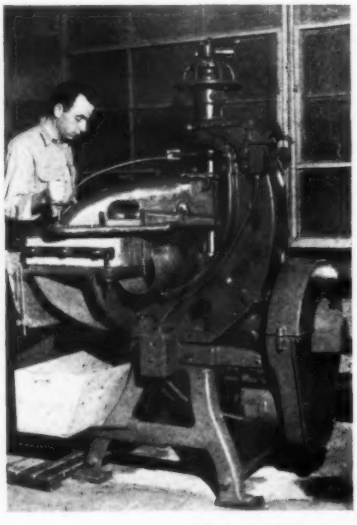


Photo by The Felters Co.

Fig. 2. As used under an Ideal Clicker on a cement floor at the W. L. Douglas Shoe Co.

* Now with the plant engineering department of the General Analine and Film Corp., Albany, New York

How to Have Attractive Lawns

By EDWARD P. B. LAURENCE

For best results lawns should be seeded in September or April . . . Preparation of the ground . . . Cost, weight and covering capacity of seed . . . Seed mixture should contain several varieties to give a good appearance at all seasons . . . Heavy seeding to crowd out weeds . . . Preparation of plot and planting of flower beds must be planned

LET US SUPPOSE that you have nothing but a bare piece of ground or a patch covered with weeds, and have to start "from the bottom up." The first necessary move is to see that there is a fairly good sod in which things will grow. An ordinary natural soil, be it sandy or clayey, is usually adequate for most things. If necessary it can be improved with commercial fertilizers applied as surface dressings when and as required.

Where buildings which have recently been located on the site of former farm land or orchards, little difficulty will be experienced. That is, provided the graders have not removed or buried most of the good top soil and brought the unfertile subsoil to the surface. It sometimes happens that near old buildings that surrounding ground is largely composed of cinders, ashes and other refuse. This must be removed and good soil substituted.

In some cases where this has been considered too costly a proceeding, soil for the flower beds only is provided and the balance of the area covered with gravel, instead of lawn. Good gravel or crushed stone varies considerably in price according to the locality and the distance from the quarries. It may cost anything from $8.00 to $15.00 a load of 5 cu yd. Gravel should be laid 3 in. deep to keep down weeds so a load will cover an area of 180 sq ft.

Its appearance, however, is not to be compared to that of a well made lawn and if the soil is not impossible a lawn is decidedly preferable. It will, in most cases, be found as cheap or cheaper to put on a layer of good soil to a depth of 6 in. as to get gravel delivered. A good bright clean gravel is however very suitable for paths and driveways.

When sowing a lawn you are working on something that you expect to be permanent, or at any rate, to last for several years. It is worth while to have the ground prepared and the seed sown by an experienced man who can be relied upon or have a reliable firm of landscape gardeners or nurserymen, or to do the work on contract.

Another point in connection with the lawn is to make sure of using good seed—good, not only as regards germination, but of the right kinds. Grass needed to form a lawn is not a single variety. A well balanced lawn grass seed mixture contains varieties which are at their best at different times of the year. Thus combined, they produce a lawn that will present a good appearance at all times. A first rate grass seed mixture should weigh about 25 lb to the bushel. About 125 lb will sow an acre unless it is desired to produce a close sward as quickly as possible. Then as much as 200 lb may be used. If this quantity is used there will be less trouble with weeds for the thicker growth of the grass will tend to crowd them out.

When buying lawn grass seed in quantity, a good mixture should be obtainable at from $35 to $45 per 100 lb. Practically any good seedsman may be relied upon to supply fair value in grass seed for the prices quoted, but in this case as in many others, the best is in the end the cheapest. If a landscape firm is given the job of making the lawn, the seed will be included in the contract, and a reputable concern may be depended upon to use seed that will produce creditable results.

Except in the Southern states, every lawn grass mixture should contain some Kentucky Blue Grass, Red fescue, English Rye Grass, and Red Top. In most states the law compels the dealer to tag his seed, not only with a statement of its purity and percentage of germination, but in the case of mixtures, to state which varieties are included.

The best months for sowing a lawn are either September or April. These months also happen to be the best for planting the flower beds, except as regards summer bedding, such as Cannas, Begonias and so forth, which should be set out in May. The best time of the year to start developing a neglected plot is in August. It can then be cleaned, plowed, and cultivated, and allowed time to settle a little till about the middle of September.

The next thing requiring attention is the arrangement of the flower beds and borders and the planting. Fall planting should be done before sowing the lawn, as the ground around the beds will be trampled. If the planting is pushed during September, the grass seed may be sown the same fall. If not, it should be deferred till the following April.

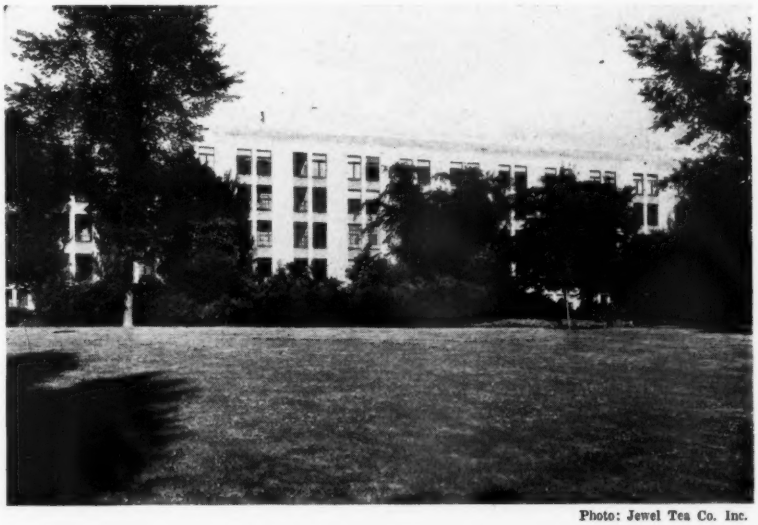


Photo: Jewel Tea Co. Inc.

An attractive lawn adds much to the appearance of a plant and to the comfort of the employees

How to Use and Install
Check Valves

BY H. J. BARTLETT, *Crane Co.*

When and where to use swing check and lift check valves. . . . How pipe friction influences selection. . . . Pulsating flow and cushioned check valves. . . . Application of six subgroups of swing checks and different types of lift checks. . . . Specific applications to various services. . . . Air compressor and centrifugal pumps. . . . Stop check valves for general and boiler service

MANUFACTURE of so many individual lines of check valves has had the effect of confusing many users as to what types of valves are best suited for various services. Basically, there are only two distinct types—the swing check and the lift check[1]. For the purposes of this discussion, only general types of valves will be considered.

Two very broad rules have been in quite general use for many years to cover the use of swing and lift check valves. The first is, *"When gate valves are required in a line, use swing check valves with them. When globe valves are used, use lift checks."* The other is, *"On liquid service, use swing check valves. On steam, air, gas or general vapor service, use lift checks."* There is considerable merit in both of these rules, although it is immediately evident that there is some conflict between them and there are quite a few exceptions to both.

It is obvious, of course, that the first rule is not very definite, for there is no general rule covering the usage of either gate or globe valves, and so we frequently find them used indiscriminately on steam, air, oil, water and gas. In a general sense, however, it is true that gate valves predominate for liquid service, because liquids flow under low head pressures, or power is expended to pump them, and velocities are usually quite low.

As a consequence, losses due to friction are important and extra precautions are taken to insure minimum resistance. For such service, gate valves have a definite advantage, and swing check valves fall into the same category, for their resistance to flow is much less than that of lift check valves. Furthermore, since the velocities are low in liquid lines, the destructive effect of *slamming* is greatly reduced.

Some notable exceptions can be made to the rule that swing checks should be used on liquid lines. For example, when there are severe pulsations in flow such as caused by reciprocating pumps, it is desirable to use cushioned check valves. No swing check can be adequately cushioned, hence it is necessary to recommend lift check valves of the proper design. Again, in the handling of volatile liquids or those which are notably hard to hold, difficulty will likely be had with swing check valves, for they are not as tight as lift check valves, and not as easy to keep in good condition.

Disregarding exceptions, it can be assumed that the greatest field of usefulness for swing check valves is in water and other liquid service. Considering very briefly the six subgroups[1] of swing checks, the following comments can be made.

Check valves with the integral disc-hinge construction can be used on hot or cold water service and on steam at very low pressures, as in heating systems. Their use should be avoided where severe wear on the seating surfaces may take place, because of the difficulty of making repairs. They should never be used on rapidly pulsating flow.

Check valves of the regrinding type can be used on hot or cold water and on other fluids not corrosive to iron or brass. Like all swing check valves, they should not be used on pulsating flow. For steam service at all save low pressures, lift checks are preferred.

Leather disc valves are recommended specifically for cold water service, especially when foreign matter is present.

Angle swing check valves are space

[1] For details of construction and use of different type check valves see Check Valves—Traffic Cops of the Pipe Lines by H. J. Bartlett, PLANT ENGINEERING, April, 1948, p. 19.

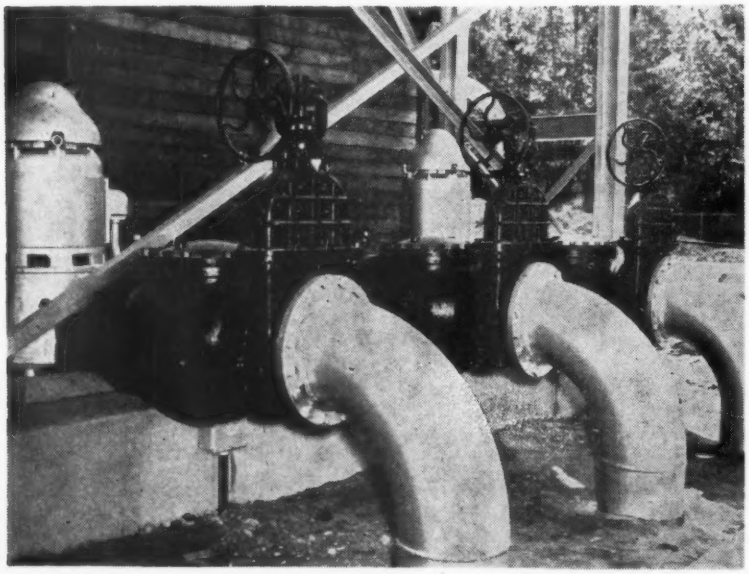


Fig. 1. Check valves on water lines from the circulating pumps to a cooling tower

Fig. 2. Brass swing check valve with regrindable disc on the bypass line for oil pressure to an incising machine elevator

and material savers, and where direction of flow is suitable can be used for the same conditions as regular swing check valves

Foot valves for cold water or other cold liquids should be of the leather disc type, providing such other liquids are not destructive to leather. Where centrifugal pumps discharging against high head pressures are used, it is preferable to use a leather-disc swing check valve in place of a regular foot valve.

Lift check valves are definitely considered to be superior to swing check valves for service on steam, air, gas, and vapors in general. The deciding factors which influence choice in this case are that gases are usually much harder to hold than liquids and the velocities used are much higher. No shop difficulties are experienced in making lift check valves tight on such service, but swing checks offer a much more serious problem. Regrinding type swing checks can be made to pass an air test in the shop after special lapping, but a few operations might possibly cause them to leak again.

Slamming of the disc in a swing check valve at both extremes of its movement is highly destructive, and this action is intensified as velocities in steam, air, and vapor lines are at least twenty times as great as in liquid lines. Knowing that even in liquid lines swing checks sometimes pound themselves to pieces, it is easy to imagine what happens to them when the velocities are so enormously increased.

Summarizing general service recommendations for all lift check valves, the following comment can be made.

All metal disc lift check valves of the globe, angle, and vertical types are suitable for use on steam, air, gas, and general vapor service, providing there are no severe pulsations in flow. Valves for air and gas should be specially ground and tested. All of these valves may be used on hot or cold liquid service, provided low resistance to flow is not a major objective.

Composition-disc lift check valves may be used on the same classes of

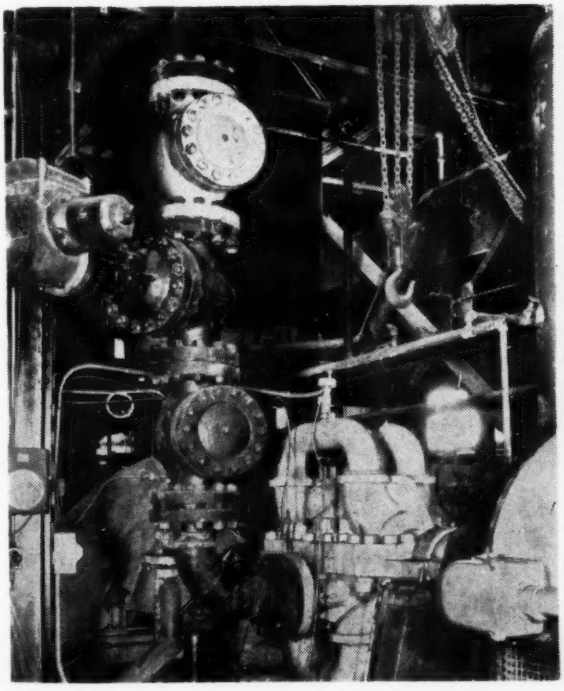


Fig. 3. Swing check valves, above and below, a motor operated valve on the high pressure side of a hydraulic pump in a wood barking plant

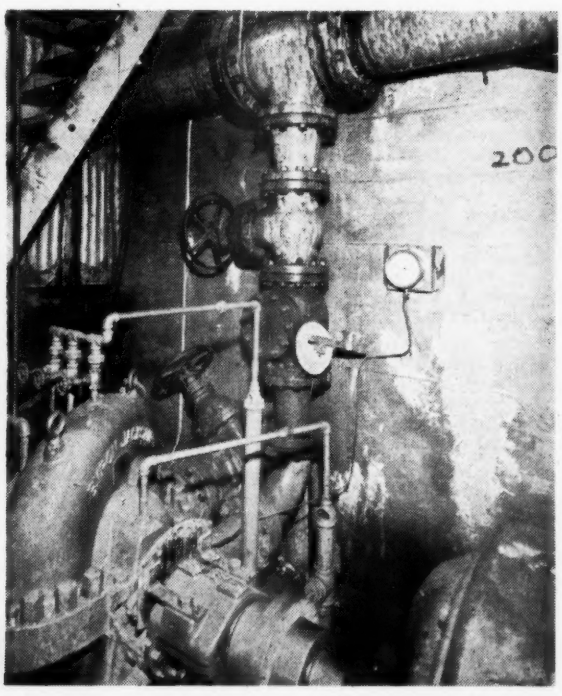


Fig. 4. Check valve with external lever and weight installed on discharge side of a centrifugal pump in a mine pump installation

service as metal-disc valves and with the same limitation as far as pulsations are concerned. For low-pressure air service, valves with soft discs are better than any metal disc valves. For extremely low air or vapor pressures, soft disc valves, with a spring above the disc to aid in closing and maintaining tight seating surfaces, should be recommended. Air service in general is hard on check valves and it is advisable, therefore, to use sturdy valves. On liquids which are hard to hold, composition-disc valves with suitable discs will stay tight longer than metal-disc valves.

Ball-type lift check valves are frequently used on services where gummy deposits are liable to form on guides and seats to such an extent that the ordinary type of valve might not operate properly.

Cushioned-type lift check valves should be used on steam, air, gas, and all liquid service where severe pulsations in flow are present.

So far, the discussion of the application of check valves has been quite general. However, there are a number of quite common installations which are subject to more than the usual amount of grief, and the detailed discussion of some of them may clarify the statement previously made that service conditions should be the governing factors in the selection of check valves.

Air Compressor Installations: Take, for instance, the case of the average air-compressor installation. Here we have a reciprocating compressor running at speeds anywhere from 200 to 500 rpm. Most such installations operate at pressures from 60 to 120 psi. If the air storage tank is large enough, pulsations in the lines leading from the tank to the air-consuming apparatus are not usually severe and, if check valves are required, any good lift check should be satisfactory. If, however, the tank is too small, pulsations may be carried through into the discharge lines from the tank, in which case only cushioned check valves should be used.

Air-compressor storage tanks should be properly drained with an automatic trap, or oil from the compressor may be carried over into the discharge lines from the tank. This in turn is liable to cause disintegration of any rubber discs used in either globe or check valves.

The principal difficulty in an installation of this kind comes from the check valve used between the compressor and the tank. The number of impulses in this line is proportionate to the speed of the compressor, and the tank serves only to smooth out pulsations in the lines leading from it. Any ordinary check valve will soon have its operating parts reduced to a handful of scrap metal if installed between compressor and tank. Attempts to improve the performance of such valves by installing springs between discs and caps invariably fail because the compressed air is very hot and springs soon deteriorate and break. The only sound solution to this problem is to use a cushioned check valve of the best possible design, and to install it as far from the compressor as possible.

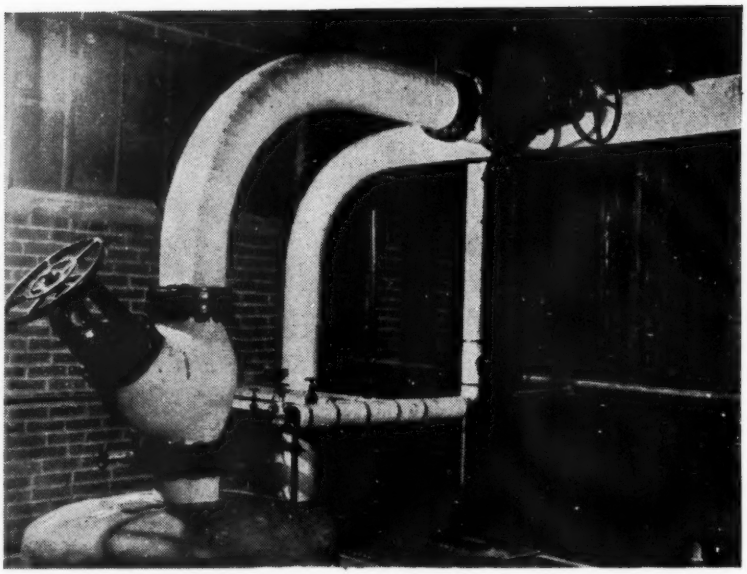


Fig. 5. Stop check valve installed on a boiler lead in a wood working plant

Centrifugal Pump Service: Going to another extreme of service, we have the case of check valves installed on the discharge side of centrifugal pumps operating against high heads. This is a common installation encountered frequently in water works service, in fire protection work, in mine pumping, and in general wherever water must be discharged to overhead tanks or elevated reservoirs. Centrifugal pumps deliver water with an absence of pulsations so that swing check valves are well adapted for this service. However, where high heads are involved there is great danger of tremendous shock pressures being built up in the line when the pump shuts down and the check valve closes.

The extent of this shock pressure is far greater than normal maximum pressure in the line and is frequently great enough to fracture fittings, valves or other equipment not having inherently high shock resistance.

Study developed that the shock pressures were built up because the flow in the line reversed itself when the pump shut down, and this reversed flow assumed considerable proportions before the discharge check valve at the pump closed. The closing of the valve with reversed flow already set up under a high head was sufficient to cause a tremendous shock throughout the line.

From this point on, the solution was simple. It was merely necessary to use a check valve which would close immediately when the pump stopped and before reversal of flow could start. This was accomplished very simply by equipping the ordinary swing check valve with an outside lever and weight in such a way that the weight aided in closing the disc. In actual service, such a valve will close when the pump stops, slightly before forward motion of the water ceases, and thus there is no reversal of flow at all.

Of all the check valves so far discussed, probably only the stop-check has been given really wide publicity. These valves were designed specifically for one important service, namely in steam lines between boilers and headers, although it has already been pointed out that they perform admirably in many other locations in piping systems.

Boiler lead service is so important, however, that particular attention should be given to them for that class of work. To start with, an automatic stop-check valve should be installed in the pipe line from each boiler to the main steam header, when more than one boiler is connected to the same header.

When so used, the valve performs several important functions. It acts as an automatic non-return and safety first valve, preventing a back flow of steam from the header into the boiler in the event of a failure or shutdown of the boiler. It acts as a manually operated stop-valve which may be closed when it is necessary to cut a boiler out of service temporarily without drawing the fire.

A gate valve is usually installed at the header so that the line may be shut down when it is necessary to work on the stop-check valve. It automatically cuts the boiler into service when pressure has been built up to a point slightly above the header pressgoing into service if it is not steaming sure, and conversely, prevents it from properly.

Portable Water Heater Aids Plastics Output

Contributed by
W.R., Erie, Pa.

TO AVOID EXCESSIVE weld lines and other imperfections when molding polystyrene and some of the harder materials, Franklin Plastics Div., Franklin, Pa., evolved a hot water circulating system that can be wheeled from machine to machine and coupled to die halves. The idea behind this is to eliminate and modify the differentials in temperatures of the plastics being molded and the cooler dies.

An ordinary electric water heater is mounted on a mobile steel base about 30 in. square. Flow of water through this heater and to and from the die halves is produced by a 1 hp electric motor also installed on the base and coupled to an ordinary water pump. Dies that get this hot water treatment are designed with special openings that couple onto rubber hosing that runs to and from this water heater. With the aid of this circulating system the temperature of a die can be kept fairly constant at around 190 to 200 F.

Hot water is circulated through extra water channels in a die with the aid of this mobile electric water heater and pump (the pump is visible at lower left side of heater). Differentials in temperatures of plastics materials and the cooling dies are then modified and better molds are produced

Barge Holds Emergency Fuel for Year

Contributed by Dravo Corp.

TO BE PREPARED for any fuel shortages that would result in slowing or stopping glass production at its Creighton, Pa. plant, the Pittsburgh Plate Glass Co. recently completed installation of standby oil-burning equipment. The burners, supplying heat at about 3000 F for manufacturing glass, now have three sources of fuel—gas from company-owned wells, gas from a public utility, and fuel oil.

One of the major problems that confronted the glass company's engineers designing the standby oil-burning equipment, was finding adequate storage facilities for Bunker C oil. No space was available on the plant grounds to build a tank of sufficient capacity.

As the plant is located along the Allegheny River and has harbor facilities for unloading sand from barges, it was decided that the solution to the problem would be storing the oil in a barge. This also would answer the question of transporting oil to the glass plant. The barge could be towed to oil company docks, loaded, and returned, with a resultant substantial savings in transportation costs.

Floating fuel oil storage tank is moored to a concrete pier by specially designed timber spars connected in a pivot arrangement that permits the barge to ride high and low water

A standard 195-ft welded steel oil barge, built by Dravo Corp., Pittsburgh, was selected for this service. The barge was already under construction as a stock unit, so prompt availability was possible. Since Bunker C oil, at low temperatures, has the consistency of tar and will not flow freely, it was necessary for the builder to make substantial changes to adapt the barge for cold weather storage of the oil.

Steam heating coils, in a sinuous pattern, are installed in the bottoms of the eight cargo tanks. Steam is supplied from the plant through a 4-in. main. The 3-in. oil discharge line on the barge is protected by a 1-in. steam chaser. On deck, the steam and condensate lines are in one conduit, the oil cargo and steam chaser lines are in another. Both conduits are encased in a larger one. Steam coils also are placed around the suction for each cargo tank. The existing 8-in. cargo discharge line, standard on the oil barge, is blanked off as it is used only during loading at the refinery. A by-pass is provided on shore to permit loading oil from tank cars to the barge through the regular 3-in. cargo line. Regular size oil pumps normally used on this type barge would be much too large for the rate of discharge required for this service. Instead, two piston-type 37 electric pumps, with 550-v motors, are employed. The pumps are kept warm by steam lines, are weather- and explosion-proof.

Because of varying water conditions in the Allegheny River, it was necessary to moor the barge to the concrete pier in a way that would permit the vessel to ride out periods of high or

low water and at the same time permit normal operation of the barge. At times, the depths fluctuates as much as 16 ft. Two specially designed mooring spars, made of 16 in. by 16 in. timbers, are connected in a pivot arrangement to the barge deck and the pier. The power, steam, condensate, and cargo discharge lines are attached to one of the spars through flexible hose which carries them to shore connections. With a capacity of approximately 350,000 gal of Bunker C, the barge holds almost a full year's emergency fuel requirements.

Skid Hoppers Speed Foundry Work

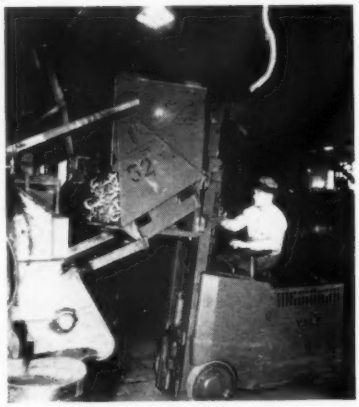
Contributed by The Yale & Towne Mfg. Co.

ONE FOUNDRY has gained extra use of its fork trucks by making use of skillfully conceived and designed truck-borne, dump-bottom, skid-hoppers. These hoppers make it possible to dump castings and forgings into hoppers and chutes which are located several feet above the floor level, by means of the fork truck, according to the Yale & Towne Mfg. Co.

The dump-hopper is basically a square metal skid bin. The bottom of the bin is hinged along one edge. Sides integral with the bottom have been bent up along the two sides of the bin. Chains, secured at one end to the bin sides, and at the other end to the bent-up sides, limit the degree to which the bottom can open.

A hook has been welded to the back of the bin and is used to hang the hopper from a notched member which has been welded to the top of the mast of the truck. The hopper is dumped merely by hanging it from the notched member, and then lowering the forks to release the hinged bottom. This dumping arrangement permits control of the flow of material from the bottom of the bin.

The loaded hopper can be picked up by the fork truck, transported to the dump area, and dumped into such processing equipment as the tumbler shown here. The truck, of course, can also be used for such foundry applications as lifting heavy castings, tiering skid loads and pallet loads, handling raw materials, materials in process, and finished goods.



This specially-designed dump bottom skid hopper can be picked up by the fork truck, transported to the dump area and there dumped into the processing equipment

Lost Time Accidents Cut Drastically

Contributed by MacKintosh-Hemphill Co.

APPROXIMATELY 300 employes of Mackintosh-Hemphill Co. are establishing a unique safety record at the company's Midland, Pa. plant. There has not been an accident at this steel roll and mill machinery plant to cause time lost from work since December 4, 1946. According to Irvin A. Brinkman, director of industrial relations, this fourteen month perfect safety record is the best performance for Midland plant workers since 1939.

Fig. 1. Safety sign in front of Mackintosh-Hemphill Co. Left: Side seen by employees as they leave plant. Right: Side seen upon entering the plant

The 400 Garrison plant employes of Mackintosh-Hemphill Co., in Pittsburgh's South Side, attained a better industrial safety record in 1947 than in the preceding year. There were only four accidents causing 34 days of lost time last year compared to six accidents involving 63 lost time days in 1946.

"Taking into consideration the fact that plant employes are constantly working on and around castings weighing from 5 lb to 75 tons," reports Mr. Brinkman, "we feel that the safety records were outstanding in 1947.

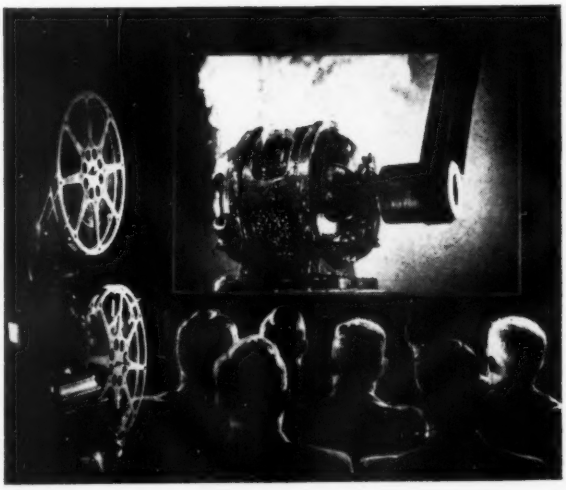
How Fires Start in Industry

Contributed by Associated Factory Mutual Fire Ins. Cos.

AN EDUCATIONAL sound film titled "How Fires Start in Industry," produced by Associated Factory Mutual Fire Insurance Companies vividly portrays many of the common causes of fires in industry—fires which cost the country many millions of dollars each year. The film is of interest to both plant executives and operating personnel.

Subjects covered by the film are as follows: how worn portable cords may start fires; how poor connections at switchbox may cause arcing; what happens when a motor stalls and roasts; why bridging of fuses is dangerous; how static sparks may set fire to flammable liquids; how foreign material starts fires in cotton pickers; how improper disposal of sweepings may cause fires; and many other.

Projection time for this 16 mm Kodachrome sound film is 30 minutes and the film may be obtained free of charge (by industrial plants and business organizations) subject to prior bookings. The film is loaned for one-day use unless otherwise arranged and return shipment must be made express prepaid by the user, insured for $150.00. Copies are available for purchase at $150.00 each, including reel and can. Inquiries should be addressed to Inspection Department, Associated Factory Mutual Fire Insurance Cos., 184 High St., Boston, Mass.



This photograph shows one of the scenes in the movie, "How Fires Start in Industry." An overheated motor is catching fire because it stalled

Hot Well for Boiler Plant

Contributed by
Myron C. Ziemke

THIS HOT WELL is at a low point in the heating system and the float-switch-operated pump returns the hot water to the boilers. The corrosive effect of the mineral-laden water required the use of either stainless steel or heavy plate. With the former in short supply, $\frac{3}{8}$ in. plate, shear cut and reinforced at the angles with 2½ by 2½ by $\frac{5}{16}$ in. angle stock was used as second choice.

Note that the float switch is securely mounted on the decking and requires no additional support. The guide sleeve for the float rod was dropped through a torch-cut hole and later welded into place. A third feature, not shown in the sketch, is a 24 in. manhole, the cover of which is the same plate that was removed with the torch, plus a supporting flange and a hinge arc welded in place. This means is used to gain entry to the tank for the annual replacement of the trust resistant paint.

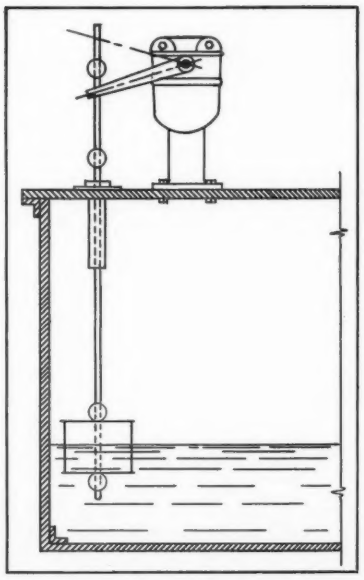


Fig. 1. Hot well of steel plate and angle stock fabricated by arc welding

Calculating Belt Load For Bearing Sizing

Contributed by
Fafnir Bearing Co.

BEFORE deciding on the size of ball bearings for any particular position, it is essential to know the radial and thrust load to which the bearings will be subjected. Of all the loads, the most troublesome to compute is the belt load.

Actual belt tension may be totally out of proportion to the actual useful turning effort transmitted to a shaft; atmospheric conditions cause belt tensions to vary; belt is made in a variety of materials and thicknesses; centrifugal force has its effects on fast-moving belts.

The combination of these factors makes it difficult to estimate with any accuracy actual loads due to belt tension.

Consequently it is accepted practice to use the average possible load for a given belt, considering the sum of the tensions on each side. This insures selection of a bearing with ample capacity.

Interior Scaffolding for Painting and Cleaning

Contributed by
Jos. E. Seagram & Sons, Inc.

The erection of safe and efficient scaffolding and the proper methods of working on it is explained in this latest information from Jos. E. Seagram & Sons, Inc. This firm points out that safe scaffolding is one of the most important phases of wall cleaning. Some of the more common types used in wall and ceiling work are covered in the accompanying drawings.

The entire system consists of combinations of A-frames and extension ladders and has been found by Seagram to give their sanitors the greatest protection while performing their daily jobs. Exacting methods have been laid down which must be followed by Seagram's Sanitors, in order to promote safety.

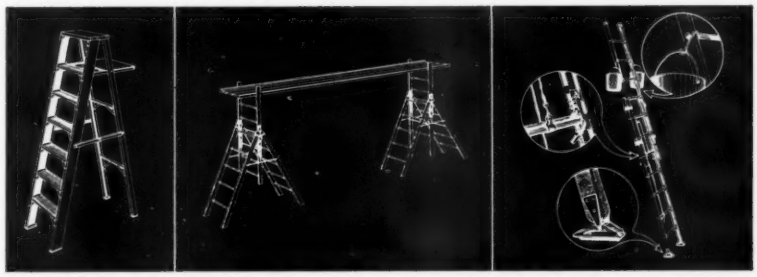


Fig. 1. A step ladder suitable for wall washing. Note that the steps are made of corrugated, flat material not less than 3¾ in. wide riveted to the side beams. The steps and side beams are adequately braced to prevent the ladder from folding in a sideward direction. The ladder is equipped with hinged braces to prevent it folding while in use. Side beams are of sufficient strength to hold 500 lb; they should be rated by the manufacturer at 1000 lb. The feet of the ladder are equipped with rubber pads or buttons. It also has a wide top step and a platform suitable for holding pails. Fig. 2. This is a scaffold arrangement designed for use in unobstructed areas. It consists of two A-frames and a scaffold board. All scaffold boards should be tested for at least three times the weight they are expected to hold. In all instances where two men work on a single scaffold board one man should begin at the end and work toward the center; the other should work from the center to the opposite end. Fig. 3. An extension ladder, equipped with two S-hooks for holding buckets is used where obstructions prevent the use of step ladders. The base of the ladder is equipped with suitable safety shoes. A close-up diagram of the ladder lock is also given

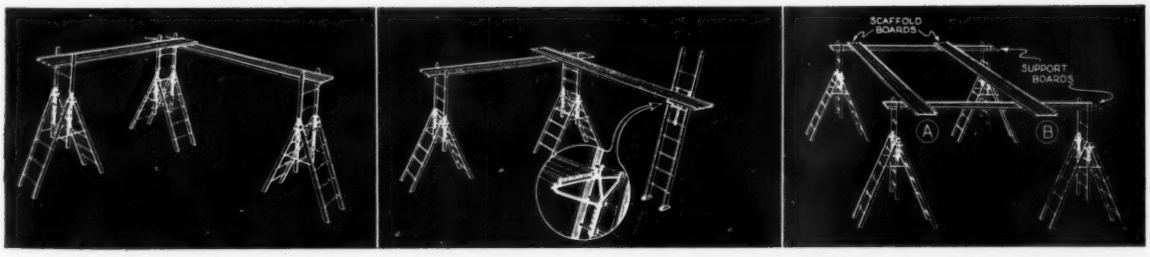


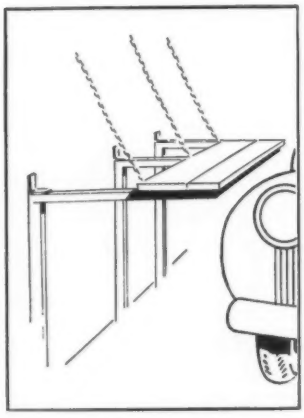
Fig. 4. An L-type scaffold is suitable for use on corner walls. It can be made, as shown in the illustration, with three A-frames and two scaffold boards. Fig. 5. Another type of L scaffold, employing the use of a straight ladder with a ladder jack, is used where space does not permit the use of A-frames only. The base of the ladder must be adequately secured against slipping. Fig. 6. This type of scaffolding is used primarily for washing ceilings. It is used in some wall work. The arrangement consists of four A-frames and four scaffold boards arranged as shown. Four men can work on this scaffolding. They must, however, work in pairs. Scaffold board A must be moved toward the center of the support boards. Scaffold board B must be moved from the center of the support boards toward the opposite end. In this manner the support boards do not have the entire weight of the workers in the center at one time

Maintenance and Operation

Wall Rack for Painting Car Roofs

Contributed by
E. I. Du Pont

HERE is an idea that has considerable merit for the plant engineer who has cars or trucks to maintain, clean or repaint. The maker points out that the use of hinged decks on the sides of the room where cars are painted or washed provides easier access to their roofs. The fact that the racks are supported by chains and can be pushed back out of the way when not used makes them doubly effective.



Chains support this car painting rack which permit it to be pushed out of the way when not in use

Luminous Paints Prevent Accidents

Contributed by
The New Jersey Zinc Co.

LUMINOUS PAINTS were widely used during the war for a variety of purposes; for ground markers; on maps and charts; and for instrument dials, and on ships and airplanes where bright lights would have been dangerous. These paints are now available for industrial use and have found application in many ways.

Fire insurance companies recommend that fire escape doors, stairways and emergency exits be marked with luminous signs that glow for a considerable time after power failure. Light switches, door knobs, stairs and banisters painted with luminous lights or paint will save many minor accidents.

The pigments for paints, papers, plastics and printing inks used for this purpose do not employ radium or radium active material. The luminescent glow is produced by a special pigment which has the ability to absorb light energy.

If the luminous material glows only during the time that it is exposed to a black light it is called fluorescent. If it continues to glow after the exciting light is removed or extinguished, this luminescent glow is known as phosphorescence or, because it continues to glow after exciting lights are removed, the effect is also called the afterglow or luminous. This is the type that glows in the dark after exposure to daylight, lamplight or black light.

Some of these luminous materials glow for only a short while but one of the developments resulted in luminous pigment that glows all night once the paint has been fully charged.

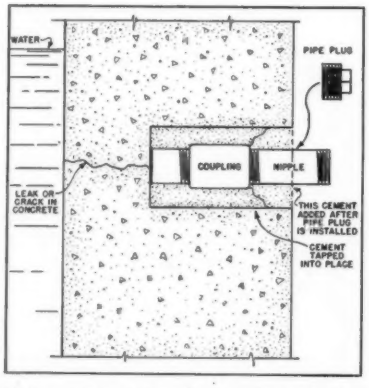
One Way to Stop Leaks in Concrete Walls

Contributed by
H. B. McDermid

THE ACCOMPANYING drawing is almost self-explanatory. It shows the manner in which one resourceful engineer plugs up cracks and holes in concrete walls. This method is useful where a static head of water in back of the wall is causing it to leak.

A hole is drilled in the concrete wall at the point of the leak. A short ½ in. nipple screwed tightly into a coupling and sealed is then inserted in the hole and another nipple is loosely screwed into the other end of the coupling in such a manner that it projects past the wall.

This entire assembly is then fastened into the wall by tamping a moistened cement mixture into the hole surrounding the assembly. This allows the water to flow through the pipe and lets the cement mixture harden and cure. When it has hardened sufficiently the outside nipple is removed from the coupling, a pipe plug is inserted and the hole filled in with another mixture of cement. When this latter has dried the wall may then be painted or finished in any other manner. The leak will have been stopped.



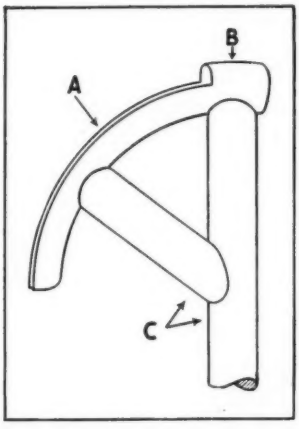
Make certain that the coupling is far enough inside the wall to allow the pipe plug to be recessed and thus covered with the final coat of cement

Bending Aluminum Conduit

Contributed by
Aluminum Co. of Canada, Ltd.

EXPERIENCE has proved that tools designed with sufficient bearing areas and proper radii will make excellent bends on aluminum conduit.

In the accompanying drawing, A is a curved iron pipe one size larger than the conduit to be bent. A half section is cut away except for a 1 or 2 in. collar (B) at one end. The curved pipe (A) is welded to a steel pipe frame (C). The curvature of the bender should conform to the required conduit bend and should extend through 90 deg. so that the conduit does not have to be moved as bending progresses. This results in an even bend with no buckling.



This is a simple and satisfactory type of hand bender. For 1 in. conduit part A should be 1¼ in. standard I.P.S. (steel) and part B should be 2 in. of the same material

All edges that come in contact with the conduit should be rounded and the whole working surface should be smooth so that the surface of the conduit will not be damaged. Hand benders of this type are easily fabricated in the shop. Similar benders of standard type that are available on the market also will produce satisfactory bends on aluminum conduit.

Conveyor Aids Tannery Operation

Contributed by
Tanners Council of America

IN THE PLANT of the Moench Tanning Co., Inc., Gowanda, N. Y., up-to-date methods are the rule. The method of drying hides is an example. Before passing the hides through the drying tunnel they are pasted to large glass plates which are suspended from a Monorail conveyor chain. Temperatures in the tunnel used for drying are from 130 to 150 F with a relative humidity of approximately 50 per cent. This set of conditions permits a drying time of from 4 to 6 hr.

The heat in the tunnel is supplied by unit heaters with fin coils in front of circulating fans. The glass plates, with the hides attached, are drawn through the dryer by the conveyor chain which has lugs over the top of the plates. The plates progress through the dryer at the rate of about 16 ft per hour. Outside the dryer the plates are drawn by hand supported from the Monorail track.

Photo: The Tanners Council of America

One of the recent innovations in leather drying consists of this large glass plate which is suspended from a Monorail conveyor. The hides are pasted to this glass and pass through the drying tunnel. The pasting operation keeps the leather smooth and flat

Questions and Answers

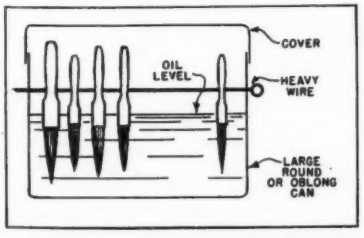
An open forum for the discussion of, and airing of opinions on, questions of interest to plant engineers. Send in your questions or problems to be answered and discussed by practical men in the field. Answers to, and discussion of, questions are solicited. Material selected for publication will be paid for and, upon request, name and company connection will be withheld

Wanted: A Positive Way to Clean Paint Brushes

Contributed by
R. J. Thompson, Cleveland, Ohio

QUESTION: S.W.A., on page 36, May issue, asked for a sure-fire method of cleaning paint brushes to prevent building up of dried paint at the heel of the brush.

PAINT brushes should never be allowed to dry out. I keep my brushes in a can of linseed oil, strung on a wire, with the bristles always covered with oil and never allowed to touch the bottom of the can. The arrangement is shown by the sketch. Eight or ten brushes of various size and widths are kept in this way so that they are always in perfect condition and ready for use. After selecting a brush it should have the linseed oil worked out on a board and the color to be used should then be worked in.



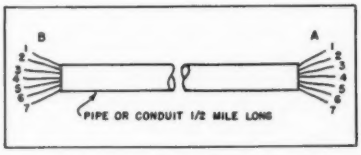
Section through the cover and can of linseed oil showing how Mr. Thompson keeps his paint brushes in good condition

It is good practice to keep one brush for white or ivory and another for varnish or lacquer, although it requires only a few minutes to work a brush out for any color. When not in use, the can should be kept tightly covered to prevent drying of the linseed oil.

A Brain Teaser for the Puzzle Fans

Contributed by
M. Podell, New York City

DURING the years gone by there have been many practical problems for the mechanic and electrician put in the form of puzzles to test one's ingenuity and to point out some application of fundamental principles. Some of these require the use of algebra or other forms of mathematics, while others do not. The following is a typical example. In the iron pipe are a number of conductors, seven have been used in the example but the principle applies equally well to any number. The electrician has a bell and a battery and is interested in identifying and tagging all the wires in the least possible time and with the least effort. To do this he stops at manhole A, then goes to manhole B, and finally returns to manhole A. He then has all conductors tagged at each end with the same number. How did he do it?



How would you identify and tag these seven uncoded conductors with the least effort? You are alone but have a battery and bell to help

High Speed Conveyor Operation

Contributed by
U. F. Neiderhiser

QUESTION: Robert Baker, on page 67 of the November 1947 issue, asked why a conveyor motor behaved in an erratic manner after the electrician hooked it up. First the conveyor took off at high speed. The electrician made another connection. This resulted in the motor running in reverse. On the third trial hook-up proper operation was obtained. An answer to this question was printed on page 31 of the April 1948 issue. Following is a critical comment on the answer.

ARE YOU trying to be serious or funny in this section? Sometimes it is difficult to tell. If Robert Baker had put his question to the plant electrician, he would have been told that with the first hook-up there was no field on the motor. The other two hook-ups are normal. There is only a 50-50 chance of getting the proper rotation in the first hook-up, unless, of course, there is a blue-print available to work from.

It is definitely an error to say that a differential compound motor will run away. Investigating Mr. Widell's formula for motor speed will show that the instant of starting the resultant field will be weak due to the series field backing the shunt field. However, as the motor starts to operate the flux due to the series field will begin to decrease and will continue to decrease as long as the speed increases. This soon leaves the shunt field in control as far as speed is concerned. The differential compound motor has a definite application in industry where constant speed is necessary with variable load.

Here's One for the Safety Man!

Contributed by
E. W., New Haven, Conn.

QUESTION: When three 60-watt fuses are installed in a box, one or the other of the three burns out frequently and it is sometimes difficult to determine which one. If 90 amp fuses were put on the two outside posts, with a 60 amp fuse in the middle, it would always be easy to determine which one blew out without having to check all three. I know of one maintenance man who has been doing this for many years. He never fails to know which fuse is blown out. Is this good practice?

He Wants That Velvet Smooth Skin

Contributed by
Ernest A. Dench

QUESTIONS: From time to time a number of our employees working in the shop have minor skin irritations and eruptions. These are usually on the hands or forearms although sometimes the irritation is more widespread. So far we have had no serious cases but we would like to know if there is not some ointment or protective coating that might be used to prevent the mild cases that we have encountered.

H. T.

DERMATITIS is a very common industrial complaint which in some plants reached very serious proportions during the war especially among women workers. There are a number of proprietary protective creams which may be used although, if possible, this complaint should receive the advice of medical men.

The accompanying formula was developed by a chemist in an industrial plant after widespread experimentation with skin protective cream formulas. It is not easily washed off by perspiration and has proven to be especially effective in shielding the skin from petroleum solvent irritation.

Formula for a protective skin cream not easily washed off by perspiration

Lanolin, Anhydrous	400 g.
Castor Oil, medical grade	400 g.
Bentonite	232 g.
Corn Starch	240 g.
Aerosol—OT—100%	30 g.
Colloresin, E. E. H.	10 g.
Grape Technical, OW Perfume Oil	¾ ml.
Trichlorobutyl Alcohol	8 g.
Water	2200 ml.

Before the formula was adopted by the plant where it is used, it was submitted to the medical director of the U. S. Public Health Service and received the latter's endorsement. The formula given is sufficient for 1 gal of cream.

Plant Engineer's Digest

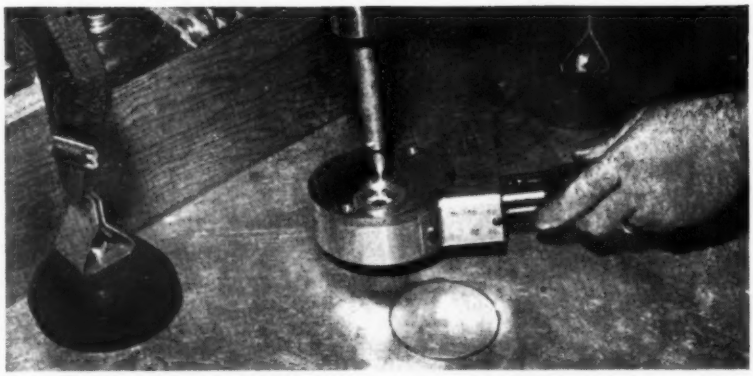
Short articles selected from current publications and condensed for quick reading to save time and give quick reviews of a wide range of industrial topics

Vulcanizing Metal on the Spot

A METHOD OF repairing tears or holes in Honeycomb paneling or flooring has been developed by the Glenn L. Martin Co. It is widely used in their airplanes and can be applied to other fields where this paneling is used extensively. Honeycomb is a sandwich of plastic impregnated cloth, kraft paper or aluminum foil bonded to faces of thin metal, wood, plastic or other sheets. It offers great strength with little weight.

The repair method and a small portable kit containing the necessary materials is the product of several men in the Martin organization.

The tear in the hole is first measured as the patch must be slightly larger than the hole. The area is



This photograph shows the heater being removed from the completed patch

then thoroughly cleaned. From the repair kit comes the necessary materials including precured patch plates of various sizes, steel wool, cheesecloth, acetone and other chemicals. A coating of plycozite adhesive is applied to the face of the Honeycomb with a brush and the core of the Honeycomb at the tear is filled with a mixture of synthetics. A ring ¼ in. high is then placed around the tear and a heater, with a temperature of 300 F, is applied for 20 min.

After a 10 min. setting following removal of the heat, the patch plate (plycozite coated as is the paneling again) is applied and an arbor supplying 10 psi holds the plate in position during another heat treatment. *From The Martin Star a publication of the Glenn L. Martin Co., Baltimore.*

Guy Derricks for Heavy Construction

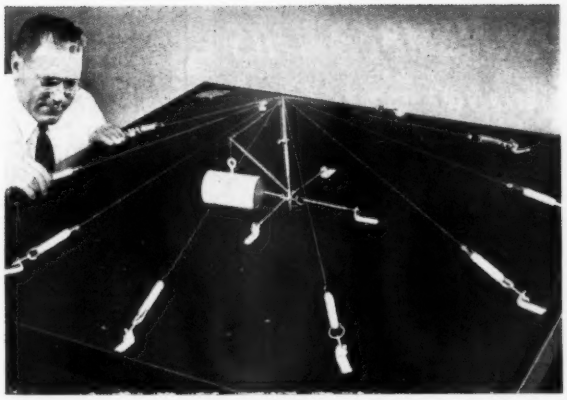
GUY DERRICKS are now in common use particularly in the refineries where since the early 30's construction has expanded into higher and heavier vessels. In 1932 after 20 years' experience with guy derricks in the building of large hydro electric power plants, Kellogg introduced the guy derricks in refinery construction on a job for the Marathon Oil Co. at Bristow, Oklahoma.

Two identical lube oil units were installed, one by using a guy derrick and the other without. The saving in installation costs favored the derrick by 18 per cent. This paved the way for widespread use of derricks in refinery construction.

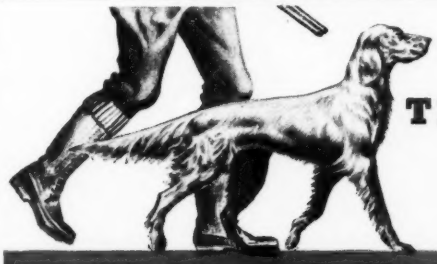
In 15 yr the general appearance of a guy derrick has not changed a great deal. A central 150-ft mast aided by eight or ten guy wires supports a hinged boom so attached to the mast that it can swing upward through any angle from 0 to 80 degrees.

The mast is fitted with a bull wheel for horizontal rotation. The complete assembly itself is often mounted on a steel pedestal 50-100 ft high. Such derricks tower 250 ft in the air and are required to show light beacons so that passing aircraft will not collide with them.

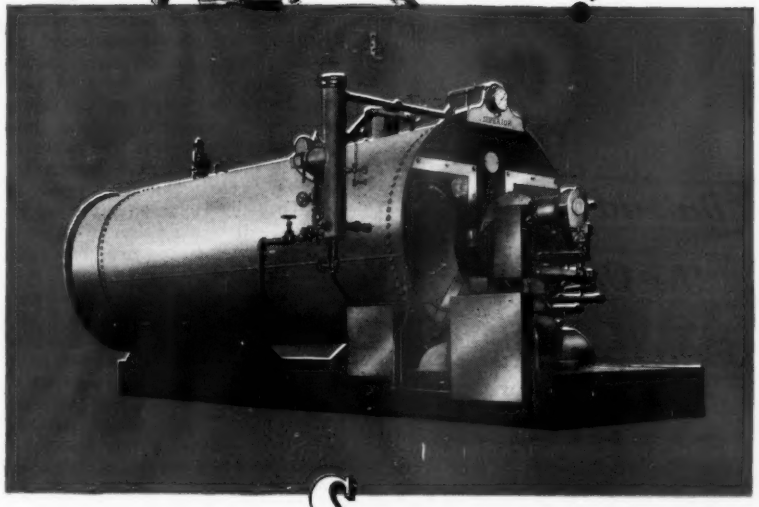
As the size and weight of installations increased, the factor of safety built into the original derricks left considerable doubt as to actual conditions. Kellogg construction engineers built a small scale experimental guy derrick with spring scales in one or more of the guys. From the model data thus obtained the strength of the wire required for the actual job can be predicted with accuracy. In practice it has been observed that if ten guy wires are used the great bulk of the load usually hangs on three guys. If eight guy wires are used, the load usually hangs on two. In many cases it has been possible to achieve the same



Model guy derrick used for studying large scale construction requirements. Readings from the spring balances in each spring guy are used for accurate determination of guy wire sizes on full size rigs



THOROBREDS BOTH



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REMEMBER THIS about couplings

there are gear types —and there's the

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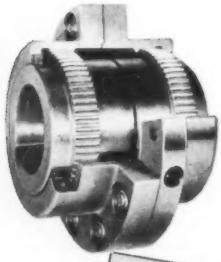

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strength yet save money by using ten guys of small diameter rather than eight guys of a large diameter. *From The Kelloggram, a publication of the M. W. Kellogg Co., New York, N. Y.*

Skin Treatment for Plywood

PAPER-PLASTIC surfacing of plywood brings plywood three major improvements. These are: increased tensile and flexural strength, a lower rate of moisture absorption, and an excellent surface for subsequent painting and finishing. In addition, it minimizes checking difficulties, resists temperature extremes, weather, abrasion, acids and organic solvents, and is non-splintering.

Tough and durable, this new important structural material consists of special paper stocks impregnated with Bakelite phenolic resins. In the initial production stages of this material, Kimberly-Clark Corp. combines water-soluble phenolic-resin with paper in the paper making process to produce grades of "Kimpreg" plastic paper specifically designed for plastic surfaced plywood. The plywood manufacturer then lays up the uncured paper stock with his glue spread veneer assembly between suitable metal cauls and cures both the paper and internal plywood glue bonds in a conventional plywood hot press. All the Kimpreg surfaced plywood now in production is designed as an industrial or utility product rather than a decorative panel.

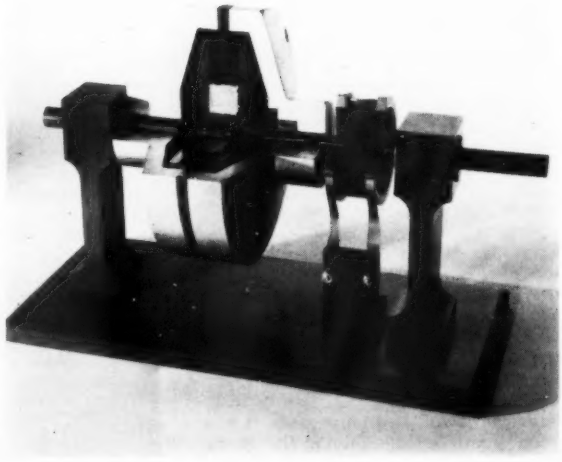
As a concrete form material, paper surfaced plywood has proved to be extremely economical and serviceable. Since this material can be reused scores of times, it lowers the ultimate cost. Plywood panels protected with paper-plastic surfacing also strip easier, clean faster, demand little oil or oiling labor and thus reduce maintenance expense.

This material's smooth, snagproof surface and its resistance to abrasion, stains and water have resulted into use as tops on tables, counters, and as workbenches in stores, factories and plant cafeterias. Among its other uses are shelving and small-parts bins, pallets for intra-factory use, delivery chutes for packages and bulk materials where its abrasion resistance and low coefficient of friction are of value, and linings for freight cars and truck trailers to which it imparts abrasion resistance, and, in insulated cars or trailers, low moisture vapor permeability. *From Bakelite Review, a publication of Bakelite Corp., New York.*

The Magnetic Fluid Clutch

THE MAGNETIC fluid clutch operates on the following basic principle: When the space between two parallel magnetic surfaces is filled with finely divided magnetic particles and a magnetic field is established between the two plates, the magnetic particles bind the plates together against movement parallel to their surfaces. The magnetic particles may be finely divided iron which, for most applications is mixed with a liquid, such as oil, to prevent packing and to afford smoother operation of the clutch. When a portion of this mixture is acted on by a magnetic field the iron particles are mutually attracted, bind together in the field, and the mixture seemingly "solidifies"—an effect readily demonstrated by lowering a small permanent magnet into a beaker of the iron-oil mixture.

Advantages of the magnetic fluid clutch have been shown by preliminary study at the National Bureau of Standards. Extreme smoothness



Cutaway model of a simple multiple disc type magnetic fluid clutch. The electromagnet for energizing the magnetic fluid which normally fills the clutch casing utilizes the coil windings in the center of the clutch. By varying the strength of the magnetic field, which in turn controls the degree of locking between the driving ring and the driven plates, any value of torque up to locking can be transmitted to the driven member (attached to the right hand shaft)

of action is one advantage; this smoothness is due to the fact that all contacting surfaces, both of the plates and of the iron powder, are coated by a lubricant. Furthermore, the clutch is easy to control and requires very small amounts of electrical power. The control is smooth from the minimum, which is determined by the viscous drag of the oil, to the maximum, which is determined by the magnetic saturation of the iron. Another unusual and desirable feature found in some forms of the magnetic fluid clutch is that the value of static friction does not differ appreciably from the value of kinetic friction. Hence, no discontinuities in torque exist at the instant of initiation of slip. This feature is one of the principal reasons for smoothness of the clutch action.

Many possible uses for the clutch have been suggested by experiment. The automotive application is, of course, the most obvious. Unlike fluid couplings of the type now common in automobiles the clutch is not a speed-sensitive device. If the load is below the slipping torque of the clutch no slippage occurs and the mechanical efficiency of the clutch is 100 per cent. The feature which particularly adapts the new clutch to automobile use is its controllability which makes it especially attractive for use on automatic transmission where permanently engaged gear trains are clutched in and out, depending upon the speed ratio required. Since the amounts of electrical power required to control the magnetic clutch are small, it is a simple matter to interlock the electrical circuits with the speed, throttle setting, power demands, etc.

The field where these new clutches are expected to find their main application, however, is in servomechanisms. Here, friction clutches have been used but some of their characteristics are not too desirable for the work done. Another broad field of applications is in constant torque and overload devices where the clutch need never be de-energized. Permanent magnet clutches are particularly useful for such service. *From Technical Report 1213, a publication of the National Bureau of Standards, Washington, D. C.*

Editor's Note—According to the Technical Reports Section of National Bureau of Standards, the United States Government has applied for certain patents on the magnetic fluid clutch. When the situation finally is resolved the Government most likely will grant on an equal basis to all manufacturers, non-exclusive, non-transferable, revocable licenses for the manufacture of the clutches. The Bureau has informed Plant Engineering that several manufacturers are considering producing this type of clutch and are already making them experimentally.

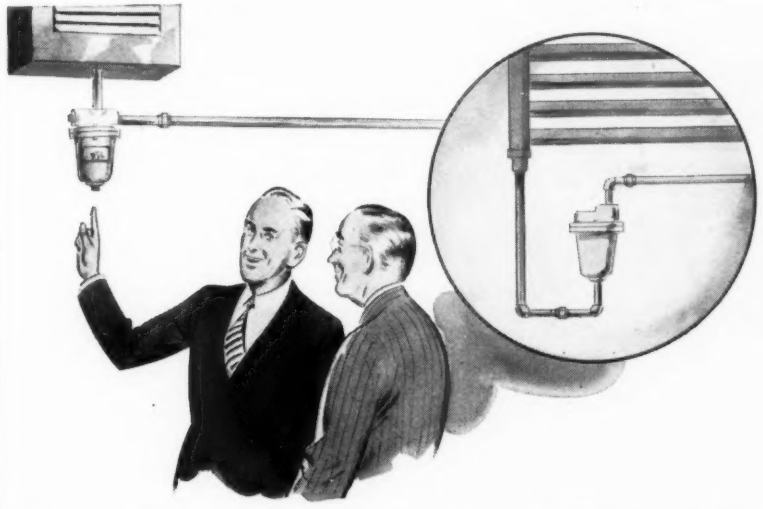
Clean Water Bill Before Congress

CLEANING up the waters of the nation's streams, rivers and beaches and prevention of further pollution by municipal sewage and industrial wastes is proposed in a bill now before Congress (S-418). The proposed law would authorize the United States Public Health Service to render assistance to the individual states and industries in controlling pollution of rivers and harbors by rendering technical and financial aid.

According to sponsors of the measure the problem of pollution has reached a stage where it can no longer be handled by the states without Federal aid. Excessive pollution endangers public and industrial water supplies, reduces value of bathing and recreational facilities and reduces usable shellfish producing areas.

With the exception of coal mining interests the bill has been given general support in the majority of its objects. The measure is not a control bill by which a plant or factory could summarily be fined or its officers be thrown into jail. It includes cooperative action with the states in the mutual desire to lessen the evil.

It is estimated that close to a



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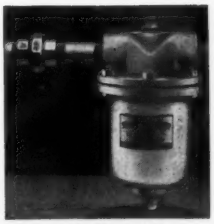
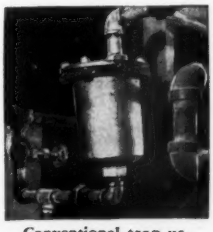


Super-Silvertop showing one nipple and one union needed.



Conventional trap using seven fittings and two unions.

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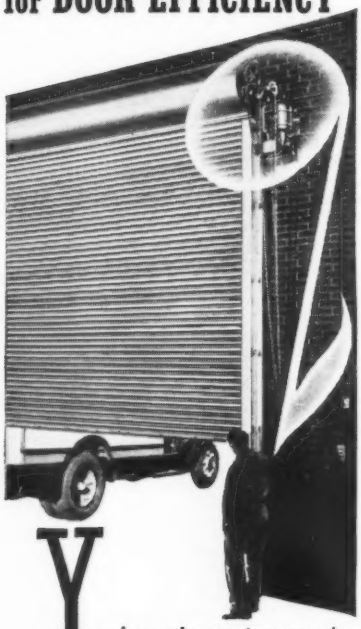

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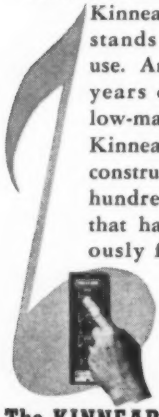

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Saving Ways in Doorways
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ROLLING DOORS

thousand industrial plants in the country have already installed treatment works. Others are studying the problem. Some industries have difficult problems in the treatment of their wastes. The treated wastes should be free from objectionable odors and tastes and also be biologically germ-free. The Ford Motor Co. is engaged in studies in combining various types of waste water that will neutralize itself. The possibility of removing usable chemicals from the wastes is also under study at several plants. The salvaged chemicals may pay for the recovery and at the same time produce clean water. The Government has a small research station in Cincinnati which is engaged in studies of stream pollution. *From Industry a publication of the Associated Industries of Massachusetts, Boston.*

How Do You Buy Lubricants?

SOME PLANTS have set up a system of specification buying, which can best be described as a sure way to get cheap products. But are cheap lubricants what you want?

Unfortunately, a set of physical properties specified for a lubricant is but an invitation to the supplier to search his stocks for a product that will meet the specification at the lowest possible price. It is true that specifications are written to provide "adequate" performance, but there is quite a difference between that objective and the *maximum* performance of products designed, not to any given standards, but to give the best returns from a standpoint of cost per unit produced or cost per year of the machine.

Physical specifications alone cannot be accepted as a measure of quality in a lubricant. They must instead be regarded as setting up minimum requirements for the average application.

There must, of course, be some guide to the supplier as to viscosity of lubricant considered by the machine builder as most desirable. We cannot leave everything to the lubricant supplier without any check, but at the same time it is not sound purchasing to put a high board fence around the product in the form of specifications arbitrarily established.

Some buyers purchase by trade name based on: (1) Prior experience with the product involved; (2) Assurance of integrity and experience of the firm through purchases of other products.

It is, nevertheless, desirable to maintain a reference file of correct grades for at least the more critical applications of spindle oils, hydraulic oils, gear oils and greases. The building up of such a file is not an easy matter from data supplied with most machine tools, but your lubricant

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supplier, if he is on his toes, has engineering staffs that are fully equipped to aid in this detail.

The last consideration in lubricant purchase, and very often erroneously the first, is price of the lubricant. In considering a "just passing" product versus a quality product, let us examine the real difference in lubricants, using a specific example: A low priced hydraulic oil used in a certain industry was found to operate a machine tool for 1500 hr before the saturation point of the oil was reached. In the same machine tool on the same work, the same operator, a treated hydraulic oil was found to operate 3250 hr before like deterioration occurred. The specification hydraulic oil was 27 cents per gallon. The premium oil was 64 cents per gallon. The machine tool held 35 gal. The cost of the specification oil was $9.45: Cost of the premium oil was $22.40, but the cost per hour of the premium oil was $0.00689 as against $0.0063 for the specification oil. By simple subtraction, we find that the premium oil has cost $0.00059 per hour or $1.23 more per year.

This is what you get for the $1.23: First, to change hydraulic oil it is necessary to take the machine out of production for at least an hour. Secondly, we have to pay for the hour's labor of changing oil, which we believe in today's labor market, has already justified the $1.23. Of more importance, however, in this example we were able to keep pace with the deterioration of the oil through a sampling procedure and remove both oils at the same degree of oxidation.

Had we left the oils in the mechanism beyond this point, as is often done, the specification oil would have caused trouble, or at least formed the base for future trouble, while the premium oil still had a large margin of safety left even though gums had formed. This was borne out by replacement of pump units at monthly intervals. Costs of the pump units and labor is not included in the above figures. Since operation on a quality, inhibited oil, no replacements have been necessary.

At elevated temperatures encountered in the hydraulic mechanism, the low priced oil had a viscosity index of 44.5 as compared to a viscosity index for the premium oil of 54. With this low v.i. oil we can expect more pump slippage, less protection for valves and working parts due to higher temperatures than would be expected of an oil with a higher viscosity index. At starting temperatures, the lower viscosity index oil, being heavier, slows pump delivery and increases temperatures through increased fluid resistance.

Another important point where differences are evident in performance qualities of oils and not indicated by physical specifications is in oxidation stability. In oils containing a greater proportion of unsaturated hydro-carbons, oxidation will occur (forming gums and sludges) at a much greater rate than in a more stable oil. — *From The Houghton Line, a publication of H. F. Houghton & Co., Philadelphia.*

Floor Pads

(Continued from page 26)

required area, and placed in contact with only part of the foot.

If the felt must be cemented to a creosoted wood block[1] floor, the creosote must be thoroughly cleaned off, to the wood, using gasoline or benzine. The wood is then covered with a thin coat of suitable cement[2] (Eagle brand or similar) which has been diluted with an equal amount of alcohol. This coating is allowed to dry for several hours and the installation is then made as described above. If it is desired to relocate the machine the cement is quickly dissolved with alcohol and the pads may be used again.

The cost of felt[3] suitable for this application runs approximately: $1.50 per sq ft for ¼ in.; $3.00 per sq ft for the ½ in.; and $5.50 per sq ft for the 1 in. material. These prices will, of course, vary somewhat with quantity, grade, and different manufacturer.

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Heat Transformations

Heat by Archie G. Worthing and David Halliday. Size 6 by 9 in; 522 pp; illustrated; cloth bound. Published by John Wiley & Sons, Inc. Price $6.00.

The authors, Professor of Physics and Assistant Professor of Physics, respectively, have presented here the fundamental laws and principles involved in transformations associated with heat. Experimental methods are emphasized and sometimes various methods of measurement of the same physical quantity are described.

Considerable knowledge of algebra and some higher mathematics are necessary in reading this book. But to those having this knowledge this will be worthwhile because it presents modern and up-to-date conceptions of heat and its usage. In the chapter on the dynamical theory of heat for example the authors trace the growth of various conceptions of heat energy and later in the book they refer many of the practical operations of working equipment to the fundamental principles. Analysis of just what heat transformations occur in steam engines, turbines, refrigerating equipment, gas turbines, etc., are given and there is a good discussion of the modern conception of radiant energy.

Textbook on Thermodynamics

Thermodynamics by Lester C. Lichty. Second edition, 1948; 340 pp; 160 illustrations; size 6 by 9 in., cloth bound, published by the McGraw Hill Book Co. Price $4.50.

The first edition of this book, pointed out that thermodynamics has so baffled the average student that it has acquired the undesirable reputation of being too difficult for any but the most gifted. The book was originally written to simplify the treatment and eliminate many of the mathematical manipulations. To accomplish this the author consolidated the treatment into logical groupings from the standpoint of thermodynamic analysis rather than mechanical equipment. It also attempted to establish a better balance between vapor and combustion processes.

In the second edition the same general arrangement has been retained since it proved effective in the first, but much of the text has been rewritten to clarify the more difficult parts. The chapter on properties of mediums and processes has been divided into two, and a section on non-steady flow processes has been added. Also a section on gas turbines is now included. The chapters on availability of energy and on flow of fluids have been rewritten. The latter on flow of fluids includes material dealing with supersonic flow, Mach Number, shock, jet, and rocket propulsion and the Moody friction chart.

Technical Hand Book

TechniData Hand Book by Edward Lupton Page, Size 5½ by 8½ in.; 64 pp; illustrated; cloth bound. Published by the Norman W. Henley Publishing Co. Price $1.50.

This book is a condensed, classified summary of the usable information on the fundamental exact sciences. As a student, the author says that he found himself carrying around too many books and spending too much time looking in them for information that proved to be scattered elsewhere. Accordingly, he compiled for his own use the data contained in this book.

It is made up of notes, formulas, diagrams and tables in the fields of mathematics, physics and chemistry, and

engineering mechanics. It gives such things as formulas in trigonometry and analytic geometry with tables of logarithms, powers and roots, etc. Formulas in physics are given with tables of constants and relations in the various systems, coefficients of expansion, velocities of sound, electromagnetic wave lengths, etc. Corresponding formulas and tables in chemistry and mechanics are included.

Statistics in Industry

Introduction to Mathematical Statistics by Paul G. Hoel. First edition; size 5½ by 8½ in.; 256 pp; cloth bound. Published by John Wiley & Sons, Inc. Price $3.50.

Practicing statisticians in industry will find in this book a comprehensive introduction to the theory and application of modern statistical methods. All of the more important material basic to these fields is discussed. For instance there are chapters on frequency distribution of one, two and more than two variables, on large sample and small sample theory, on testing goodness of fit and on statistical design in experiments.

Going beyond the treatment ordinarily found in an introductory work the book also presents discussions of sampling inspection, non-parametric methods, testing statistical hypothesis against two types of error and sequential analysis.

These fundamentals are carefully explained and demonstrated to provide a broad background for understanding more advanced concepts. Extensive references are given to aid the reader in pursuing any point of special interest.

Throughout the book emphasis is placed on the functional aspects of mathematical statistics. Many illustrative examples of both the numerical and theoretical types provide a working knowledge of statistical theory in various fields, clearly written to point up what is most important in the subject and effectively organized to integrate basic concepts.

Introduction to Mathematical Statistics presents a broad introduction to classical, large sample, and modern small sample methods.

Organization and Management

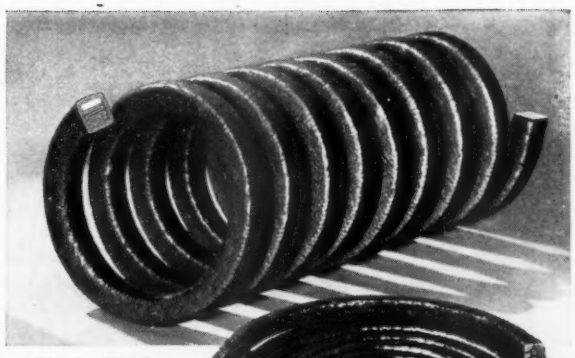
Industrial Management by William R. Spriegel and Richard H. Lansburgh. Fourth edition; size 6 by 9 in.; 656 pp; copyright 1947; cloth bound. Published by John Wiley & Sons, Inc. Price $5.00.

The fourth edition by Professor William R. Spriegel, head of the Department of Industrial Management at Northwestern University, offers a thorough discussion of the subject, including a presentation of the recent developments in the field. In addition to a new chapter on maintenance, more than 125 new illustrations have been added.

Throughout the book the author has attempted to show the relationships and interdependence of the various major departments of a business. The policies and principles of successful management and the devices required to carry them out are pointed out. Business relationships are treated with the thought that faith must be created in modern business—faith of the management in the employee and faith of the employee in the management.

The material is well arranged. Selections include: fundamental considerations; organization structure; the plant and equipment; motion and time study; wage payment; buying, selling and transportation; material and production control; and industrial relations.

Any book advertised or reviewed in this issue may be purchased from the Book Department, PLANT ENGINEERING, 53 W. Jackson Blvd., Chicago 4, Ill. Only books published in the United States for delivery in this country are available from the Book Department.



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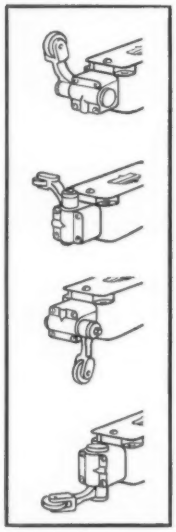
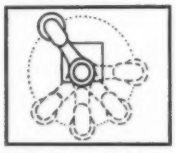
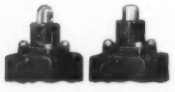


Operating head mounts in any of 4 positions, top, bottom, right or left shown above.



Roller lever may be set in any of 90 different positions, 4° apart as shown above.



Push roller or push rod operating head also available.

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Bulletins . . . . Catalogs

Property Maintenance

101 **Roof Repair**—Bulletin B. U.-49A, 40 pages, is full of practical on-the-spot photos and sketches showing some bad roof conditions and how they should be remedied. The sketches show how the roofing materials and flashings should be applied in the proper order. Many of the photos show just what to look for on roofs of various materials and point out how these conditions can cause trouble. Johns-Manville.

102 **Oil Absorbent for Floors**—Bulletin FB-10, 6 pages explains how the product soaks oil and grease from unsafe floors. Step-by-step photos show how it is applied and used. Safety and Maintenance Co. Inc.

103 **Steel-Wood Shelving**—Bulletin No. 196, 4 pages describes and illustrates the shelving which comes as a package and is quickly set up or altered for various adaptations. Step-by-step photos show how it is set up. Lyon Metal Products, Inc.

104 **Industrial Glass Building Block**—Bulletin 7c-2, 28 pages, contains many application and installation photos and drawings to convey the story of what glass block can do in industry. The various designs of block are given with pertinent information. Details of construction with block are given. American Structural Products Co.

105 **Acid, Alkali Resistant; Tank Lining**—This 4 page bulletin describes the tank lining made by this firm for application to tanks containing acids or alkali. Application instructions are given for the product. Available in colors. Nukem Products Corp.

106 **Non-Skid Floor Treatment**—This 4 page folder tells the story of the treatments made by this firm to make floors non-skid. The products are described and explained with cautions that must be observed. The product to be used with each type of floor is listed. Walter G. Legge Co., Inc.

107 **Darkening Concrete**—Bulletin 4780365 is a 4 page explanation of the product of this firm that is recommended by them for darkening air-entrained concrete. Data is presented on mixes to use for various purposes, compressive strength, flexural strength. The results of a test between the product and ordinary materials is detailed. A. C. Horn Co., Inc.

108 **Built-Up Roofing Materials**—Form 5597, 28 pages, is the specification book for the roofing materials made by this company. All types of materials and roofs are considered and the approximate quantity needed complete with pitch of roof, surfaces, insulation, and pertinent notes referring to each type of construction is given and discussed. Philip Carey Mfg., Co.

109 **Floor Patching**—Bulletin 15M-K, 4 pages, describes the product that is made for patching floors of concrete, stone, composition, steel or wood indoors. Step by step photos show method of preparing the floor and applying the patch. Flexrock Co.

110 **Roofing Insulation**—This 12 page bulletin explains the product and its application. Dew point charts, U valve chart, heat transmission chart, and a list of physical properties make up the technical data contained in this book. Photos are interspersed showing how the insulation is applied in relation to other materials. Pittsburgh Corning Corp.

111 **Synthetic Resin Coating**—Form 248, 4 pages, describes and explains what the product is and where it finds application. Results of acid resistant tests are given. Lithgow Corp.

112 **CO_2 System**—Bulletin AD-9017, 8 pages, describes and explains step by step operation of this fire protection system and tells how it should be installed in a room or plant requiring complete protection against chemical fires. American-LaFrance-Foamite Corp.

113 **Paints and Coating Materials**—This 6 page folder describes the Duramite pH product of this firm. This coating is said to be chemical resistant, and the chemicals it resists are listed. Surface preparation, application, and drying of the coating is discussed. The types available are listed. Morton Chemical Co.

114 **Industrial White Enamel**—Bulletin VC 403, 6 pages, describes and illustrates the many applications for this enamel found in industry. Highlighted are the claimed advantages. Vita-Var Corp.

115 **Marking Aisle Lines**—A pocket size folder that explains and illustrates the machine for painting safety or parking lines in a plant or out. Construction and flow of paint diagrams are given. Interchangeable parts explained. H. C. Sweet Co.

Mark the numbers of the bulletins you wish to receive on the no obligation, no postage card between Pages 10 and 11 and 42 and 43

116 **Vacuum Cleaning Attachments**—Form 120, is a catalog sheet which lists the many vacuum cleaning attachments available from this firm for use on their cleaning machines and hoses. Short explanation is given on how to choose attachments. Doyle Vacuum Cleaner Co.

117 **Laying Steel Mat Flooring** — Form 142, 20 pages, is the instruction bulletin on how to lay their makes of steel mat flooring and how to finish it off with the proper mixture if a smooth floor is desired. Step by step detailed photos show how the floor should be prepared, how the mat is laid and joined, filling with mastic or concrete depending on old base. Wm. F. Klemp Co.

118 **Floor Machines**—Folder AC 2, 4 pages, describes and lists the prices of the floor machine made by this firm for use in offices and factories. All the standard accessories are listed. General Floorcraft, Inc.

Tools

119 **Mobile Hand Floor Crane** — This 4 page bulletin presents the floor crane made by this firm for use in shop or plant for moving heavy bulky objects to save time. Capacity is given at max 1¼ t. 2 t capacity can be provided if needed. Photos and description included. Manzel, Inc.

120 **Metallizing Gun**—Bulletin 50A, 4 pages, presents the type 2E metallizing gun made by this firm which they say is the best all-purpose gun. The gun and its applications are discussed and pictured. The correct type of set-up of tanks, wire and gun mounting is shown. Metallizing Engineering Co., Inc.

121 **Maintenance Shop Lathes** — Bulletin G-48, 16 pages, includes a description and pictorial presentation of lathes suitable and recommended for use in the maintenance shop. These are of the bench or pedestal mount as desired. Sheldon Machine Co., Inc.

122 **Tool Sharpening**—Booklet N-212, 48 pages, contains useful information on how to sharpen tools and describes how each type of tool should be handled and the type of stone and oil to use on it. Behr-Manning Div., Norton Co.

123 **Gear and Wheel Pullers**—This folder explains, illustrates, lists prices and important points of the 2 or 3 prong pullers for wheels, gears, pulleys, made by this firm. Sizes and dimensions are given for each model. Armstrong-Bray & Co.

124 **Boiler Tube Expanders**—Circular No. E3, 4 pages, describes the several tube expanders made by this firm. Listed are tables of sizes. Price lists are also included if desired. These tube expanders are made in many styles for every purpose. Richard Dudgeon, Inc.

125 **Jacks**—Bulletin 203-A, 4 pages, describes and gives specifications for the many different types of jacks made by this firm. Prices are given for each type, size, and capacity. Duff-Norton Mfg. Co.

126 **Air Line Heater**—Bulletin No. CF-19, 2 pages, describes the air line heaters designed to aid the man who must work in refrigerated or cold outdoor air. Heater warms chilled air for better breathing. Mine Safety Appliances Co.

127 **Air Driven Electric Generator**—Form 5032, 4 pages, describes the small generator driven by an air turbine for use in locations where long electric extensions might prove dangerous.- Ingersoll-Rand.

128 **Drafting Symbol Templates** — Catalog No. 48, 4 pages, describes and illustrates each type of template offered by this firm for the use of engineers, designers, and architects. Rapidesign, Inc.

129 **High Speed Band Saws** —Form 300 explains and illustrates the several models of band saws for both wood and metal work plus the several accessories available. DoAll Co.

130 **Masonry Drill** — Bulletin HD-1147, 4 pages, presents the masonry and rock drill that can also double for chipping tool, scaling hammer, or light riveter. Specifications are given, and most of the auxiliary parts and accessories are illustrated and listed. Cleco Div., Reed Roller Bit Co.

Mechanical Power Transmission

131 **A C Adjustable Speed Drive**—Bulletin 311, 8 pages, is an explanation of how the all electric adjustable speed drive may be applied in industry and some idea of the savings in time and control to be achieved. Reliance Electric & Engineering Co.

132 **Gearmotors**—Bulletin 1815, 16 pages, describes and illustrates gearmotors made by this firm. Given are; Features of design, selection information, load classification table, Types of mounting, selection tables, dimensions, slide rails. Also presented are other power transmission units. Link-Belt Co.

133 **Over-Center Clutches** —Bulletin SDOC, 12 pages, explains and illustrates the construction and application of these small diameter over-center clutches. Capacity, hp ratings, size, release travel, and specifications are given for these units in the various sizes in which they are made. Dimensional drawings provided. Morse Chain Co.

134 **Hydraulic Couplings**—Bulletin No. 136, 12 pages, contains the story of hydraulic couplings and the claimed advantages for industrial engine and motor applications. Exploded views, phantom views, performance charts, dimensional drawings and tables help convey the story told in the text. Twin Disc Clutch Co.

135 **Elevators for Power Trucks** — Bulletin B-705, 8 pages, details what must be considered when the use of powered industrial trucks is contemplated in conjunction with freight elevators. Each step of the necessary construction to care for the

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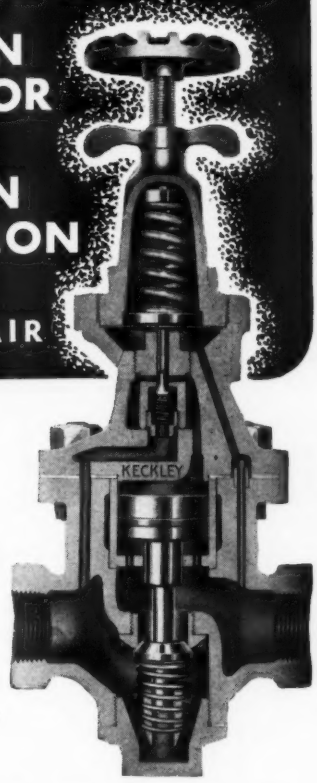

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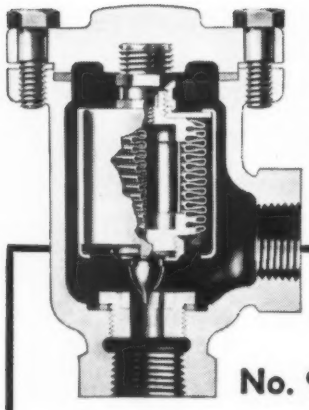

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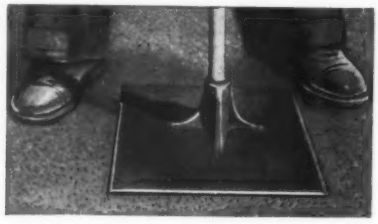

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added stress and shock is shown and discussed. Otis Elevator Co.

136 **Cable Hoists, Electric** —This eight page bulletin describes the electric wire cable hoists made by this company in capacities up to 5 t. The construction and assembly of the component parts is shown with cut-away photos of each unit. Light weight is featured. Lisbon Hoist and Crane Co.

137 **Electric Crane Truck** —Bulletin 1610-d, 4 pages, presents the specifications and salient features of this 6,000 lb capacity crane. Charts and turning radius drawings are given. Baker-Raulang Co.

138 **Overhead Handling Equipment** — Bulletin C-1, 58 pages, presents the story, pictorially, of all the many applications the overhead handling equipment of this maker of such equipment finds in modern industry. Detailed points of construction and operation, and various adaptations with auxiliaries are discussed and illustrated. American Monorail Co.

139 **Walking Lift Truck**—Bulletin POX-4610, 8 pages, contains many photos from actual applications of this walking electric battery powered platform lift truck. Highlights of construction and assembly are pointed out and explained. Specifications table given as well as dimensions. Barrett-Cravens Co.

140 **Conveying Equipment** —Form No. 647, 4 pages, describes the complete line of products offered by this firm. Listed and illustrated are: Conveyors, gravity roller, live roll, booster for elevating, portable utility, slat, belt, overhead, and vertical. Pneumatic tubes of all sizes and shapes. Dumbwaiters, Blowers and exhausters. Lamson Corp.

141 **Electric Hoists**—Bulletin 6161-A, 8 pages, utilizes cross-sectional drawings, phantom views, exploded views, to show the parts and construction of these pendant rope control electric hoists. Rating table for hoists is given. Specifications noted. Robbins & Myers, Inc., Hoist and Crane Div.

142 **Belting, Transmission and Conveyor**—This 6 page bulletin is replete with photos and drawings showing in detail the function and scope of the products of this firm. Many applications are shown in which the transmission and conveyor belts can be used. Buckner Process Co

143 **Diesel Electric Locomotives** — Bulletin GEA-4909, 8 pages, presents the several different models and sizes of locomotives made by this firm for industrial switching. Table and charts of performance on grade and with loads is given. Apparatus Dep't. General Electric Co.

144 **Materials Handling Equipment** — Bulletin TC-16, 4 pages, presents a short summary of the materials handling trucks made by this firm. Specifications tables are given for; fork trucks, both gas and battery powered, gas powered towing tractors, and truck tractors. Clark Equipment Co.

145 **Industrial Tractors** — Bulletin A-103-JJ, 24 pages, explains the many uses these tractors have. Each of the several models are discussed separately. The gasoline and diesel engines used are illustrated and the salient features highlighted. Specifications given. International Harvester Co.

146 **Mobile Bucket Loaders** — Bulletin 5M, 4 pages, presents the 2 models of mobile bucket loaders made by this company. Highlights of each model are presented with dimensional drawings, photos, and text to show the many applications possible. N. P. Nelson Iron Wks., Inc.

147 **Preventing Conveyor Overload Damage**— Bulletin No. A-46, 8 pages, describes and illustrates with many photos, drawings, sketches, exploded views, installation photos, and tables the conveyor overload cut-out. Anchor Steel and Conveyor Co.

148 **Industrial Trailer Trucks** — Catalog No. 50, 16 pages, explains the trailer trucks made by this firm. Sketches, drawings, photos of units and component parts, are illustrations. Mercer Engineering Wks., Inc.

149 **Lightweight Fork Truck**—Bulletin 1303. 4 pages, describes and illustrates the 1000 lb capacity fork truck made by this firm that is only 30 in. long and designed for car and truck or elevator loading. Baker-Raulang Co.

Electrical

150 **Fabricated Squirrel-Cage Induction Motors**—Bulletin 7000-2, 4 pages, contains 19 illustrations and a line drawing showing construction details, of these motors built in sizes from 150 to 1000 hp. Elliott Co.

151 **Automatic Voltage Regulator**—This catalog sheet explains the construction and applications for which this regulator is suitable. Unit is pictured. Richardson-Allen Corp.

152 **Renewable Fuses**— This 16 page pocket booklet describes and illustrates the construction and important features of the renewable fuses made by this firm. Prices, capacities, dimensions, are given. Company name has changed from Ware Brothers to Ware Fuse Corp.

153 **Matched Electric Motor Parts**—Form 1871, 36 pages, is the complete catalog on matched motor parts made by this firm. Described and illustrated with photos, performance charts, capacity and specification tables are the variety of motor parts divided into three groups. Robbins & Myers, Inc.

154 **Synchronous A C Generators** — Catalog section 800, 4 pages, contains many photos of these generators in disassembled condition so that construction may be understood. Up to 375 kva available. Columbia Electric Mfg. Co.

155 **Copper-Oxide Battery Chargers**—This 16 page book contains many illustrations, not only of the battery chargers but also of the strategic locating of these chargers through a plant to save the industrial trucks from having to travel a distance for fresh batteries. All the necessary technical data concerning the chargers is provided for each type and size. Appliance and Merchandise Dep't., General Electric Co.

Mark the numbers of the bulletins you wish to receive on the no obligation, no postage card between Pages 10 and 11 and 42 and 43

156 **Industrial Batteries**—Bulletin GB-749 is a 16 page book describing the research that this firm does and how they perform many tests on batteries to bring them up to their standards. Depicted is the complete laboratory for doing this work. Gould Storage Battery Corp.

157 **Time Delay Relays**—Bulletin 362 4 pages, describes and illustrates the relays made by this firm of the motor driven type. Photos of the relay and many wiring diagrams plus technical information concerning capacities and capabilities are given. Ward Leonard Electric Co.

Pipe and Fittings

158 **Stainless Steel Piping**—This booklet of 24 pages tells why stainless should be used and where. Drawings, photos, sketches, tables of wall thicknesses, chemical composition, selection of pipe joints, welder fabrication, are illustrated and explained. Tube Turns, Inc.

159 **Insulated Pipe Units**—Form 4713, 12 pages, depicts the growth of a central steam heating system in the center of a cultural group of buildings. Detailed is the manner in which the product was used to protect the underground steam lines running between the several buildings. Ric-wil Co.

160 **Hose Fittings**—Catalog Section 3100, 6 pages, describes the many fittings to be used with hose made by this firm. Photos and sketches are used to illustrate the fittings. Coupling recommendations are given for the type of hose and gas or fluid that it will handle. Notes on coupling threads are provided. Instructions provided for attaching couplings to hose. B. F. Goodrich Co.

161 **Pipe Unions**—This 4 page bulletin presents the line of octagonal union made by this firm in many different types. These unions are for 300 lb SWP with ground joints. Corley Co., Inc.

Seals and Gaskets

162 **O-Ring Seals**—Catalog No. 901, 8 pages, contains drawings of sealing methods, groove dimensions, gland diameter, a dimension table of product O-rings, and specifications. Parker Appliance Co.

163 **Metal and Asbestos Gaskets**—This 32 page catalog presents the many types of gaskets made by this firm. Photos, construction sketches, dimensional drawings and tables, capacity tables, data on areas of circles, steam table, water head table, and temperature conversion table are the illustrations that make up the bulk of this book. Spiral wound gaskets are discussed. United States Gasket Co.

164 **O-Ring Manual**—This 8 page manual contains tabulations of compound specification, dimensional standards, data on applications, and installations, and drawings show typical problems of O-ring usage. Crane Packing Co.

Pumps

165 **Packaged Boiler Feed Units**—Catalog Section 202, 4 pages, describes and illustrates the complete units and component parts. Selection table to use in choosing a unit to suit a boiler size and pressure is provided. Roy E. Roth Co.

166 **Positive Displacement Pumps**—Form No. 1751A is a catalog sheet which presents the helical rotor pumps made by this firm. A disassembly photo depicts the parts and construction of the pump clearly. Moyno Pump Div., Robbins & Myers, Inc.

167 **Centrifugal Pumps**—Bulletin No. 4711, 36 pages, presents the most recent developments in a line of horizontal and vertical shaft centrifugal pumps. The parts of the pump and their construction are explained and illustrated. Installations to which they may be applied are shown in sketches and explained in the text. Capacity, size, and dimensional drawings and tables are given. Nagle Pumps.

168 **Metering Hydraulic Drive Pump**—Bulletin PK-47, 4 pages, describes with cross-sectional drawing, photo and capacity table, the pump made by this firm for hydraulic drive for metering and proportioning. Hills-McCanna Co.

169 **Helical Rotor Oil Pumps**—This catalog sheet describes and explains the oil pumps that feature a helical rotor for claimed smooth, pulseless, axial flow. Exploded views show the few parts that are needed for this pump. Specification table and performance chart are given. Syntron Co.

170 **Air, and Liquid Handling Pumps and Equipment**—Bulletin G-82, 4 pages, illustrates and briefly describes this firm's entire line of products. Text covers the capacity and pressure ranges of the various sizes and types available in both standard and special units. These include; centrifugal and rotary positive blowers and exhausters, positive displacement meters, rotary liquid and vacuum pumps, and inert gas generators. Roots-Connersville Blower Corp.

171 **Hydraulic Machinery Stock List**—This 8 page bulletin is the stock list of the many types of hydraulic machines, pumps, power units, and presses made by this firm. Included in the lists are delivery time. Hydraulic Press Mfg. Co.

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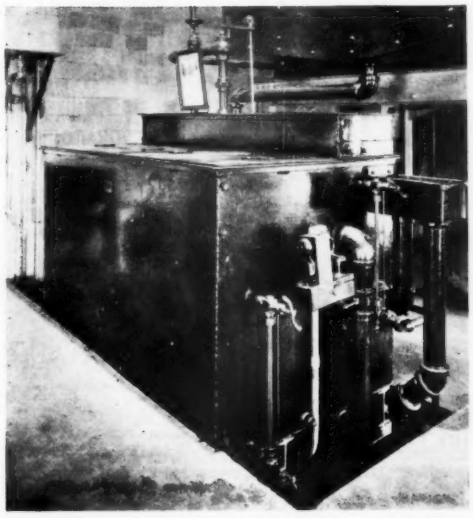

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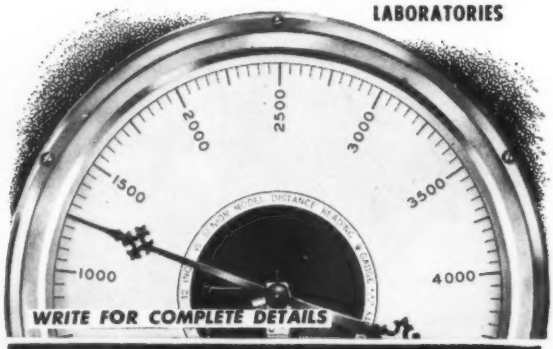

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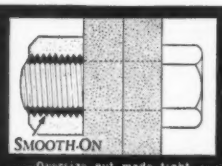

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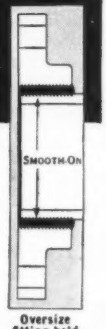

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Welding

172 **Welding Guide**—Bulletin EW-126, 32 pages, describes 3 types of electrodes used in arc welding and their use. Essentials of welding procedures are given along with the type of joints, and typical positions in which they will be found. The metals of which electrodes are made is discussed as are the causes of welding troubles and the remedy. Welding symbols provided. Hobart Brothers Co.

173 **Electrode Guide**—This pocket size welder's guide for electrodes has 38 tab indexed pages, indexed by the type of metal that is to be welded. Advice as to the method of testing metals is given and the proper filler metal outlined. There is a selection table for picking the right electrode. Air Reduction Sales Co.

174 **Bronze Welding Electrodes**—Bulletin W-17, 24 pages, describes and explains the properties of the electrodes made by this firm. Metals and applications for which each is suitable are listed. Ampco Metal, Inc.

175 **Welding Rods**—Bulletin AM-30, 4 pages, presents information on the low temperature welding rods for both torch and arc welding. Listed briefly is a description of rods to be used for different purposes for each metal by the metal. Eutectic Welding Alloys Corp.

Heating and Ventilating

176 **Low Set Ram Feed Stoker**—Bulletin 400, 12 pages, contains a complete description of the stoker made by this firm for industrial boilers and furnaces. Component parts are illustrated to point out features. Controls are explained. Installation drawings and photos show how it may be applied. Canton Stoker Corp.

177 **Extended Surface Radiation**—Bulletin B 1550B, 8 pages, describes and illustrates with cutaway drawings, phantom views, assembly photos, piping diagrams, and dimensional drawings the fin type of extended surface radiators made by this firm. Ratings and dimensions are given. Warren Webster & Co.

178 **Propeller and Axial Flow Fans**—Catalog No. 12, 68 pages, describes and illustrates the complete line of improved propeller and axial flow fans with ventilating equipment. The various types and models are too numerous to mention. Much technical information on air handling is included as well as data on the design and construction of this equipment. Propellair Div., Robbins & Myers, Inc.

179 **Plumbing and Heating Replacement Parts**—Revised Catalog D, 98 pages, is the complete catalog of this firm which makes and markets replacement parts for a wide line of plumbing and heating fixtures. J. A. Sexauer Mfg. Co., Inc.

180 **Oil Burners**—Bulletin No. 111 describes the wide range mechanical atomizing feature of these burners and illustrates the discussion with equipment and application photos, and with cross-section blue-print drawings of Types A and AB mechanical atomizers. Peabody Engineering Corp.

181 **Water Cooling Towers**—Bulletin AQ-48, 4 pages, explains the construction of the towers made by this firm. Complete description of component parts is given and illustrated. Dimensions for the 7 series available are given and a capacity table is presented. The Marley Co., Inc.

182 **Vertical Air Discharge Cooling Units**—Catalog No. 448, 8 pages, contains illustrations, diagrams, and dimensions, with full descriptions of these large units which are available. Capacities of units for cooling or condensing steam are given. Individual parts are detailed. Young Radiator Co.

183 **Selecting, Locating, Unit Heaters**—Catalog No. 147, 52 pages, is a book to help in selecting and locating unit heaters. Listed and pictured are the various models and sizes available and the construction of these units. Given are: mounting height and heat throw data, heat loss calculations, locating units to utilize construction of building, piping suggestions, piping arrangements, motor wiring and control. Dimension drawings and tables are given for models. Modine Mfg. Co.

184 **Mechanical Draft Cooling Towers**—Catalog section 37, 4 pages, utilizes complete and partial equipment photos, plan drawings, and tables of capacities as illustrations to explain the construction and operation of these cooling towers, 2K-W. Binks Mfg. Co.

185 **Steam Heating Boilers**—Catalog 92, 4 pages, presents the small round steel heating boilers and gives ratings, specifications, and dimensions in tables and drawings. Kewanee Boiler Corp.

186 **Steam Traps**—This four page bulletin gives a short discussion of the five different types of steam traps with a sketch to illustrate the type. The merits of each type of trap are discussed by this firm which makes steam traps. V. D. Anderson Co.

187 **Boiler Water Level Control**—Bulletin No. 479, 8 pages, presents the story of the boiler water level control at a large New York paper mill. Close-up photos show how the controls and valves are connected and their relation to other parts of the boilers. Northern Equipment Co.

188 **Evaporative Coolers**—This catalog sheet presents the 11 models of evaporative cooler made by this firm for cooling offices or entire small buildings. Dimensional tables are given as are specifications. Palmer Mfg. Corp.

189 **Desuperheaters**—Bulletin 6-D, 8 pages, contains illustrations and data on the SK venturi type desuperheaters, surface absorption type, and the spray type, together with diagrammatic drawings and pertinent technical data. Dimension tables and a selector chart are given. Schutte and Koerting Co.

Instruments and Controls

190 **Watthour Meter**—Bulletin GEC-350, 16 pages, describes the construction and principle of operation of the new type I-50 single phase watthour meter. Cutaway photos and cross-sectional drawings are used to explain the construction. Performance charts and tables given. General Electric Co., Apparatus Dep't.

191 **Low Resistance Ohmmeter**—Bulletin 24-25, 12 pages, contains photos, wiring diagrams and charts which assist the text in explaining the various aspects of low resistance testing. Subjects treated include testing of: cable and conductor joints, oil circuit breakers, rotating equipment, transformers and coils, and test for production machines. James G. Biddle Co.

Miscellaneous

192 **Castings Repair**—Bulletin No. 104, 24 pages, describes the process of this firm for repairing cracked and broken castings. The story of many actual repairs is told with photos. Sketches show the 4 different variations of the method of repair. Metalock Casting Repair Service, Inc.

193 **Sump Tank Cleaners**—Bulletin No. 130, 4 pages, describes and illustrates the sump cleaner made by this firm for grinding machines and machine tools. The portability of the unit is featured as are the construction and principles of operation. Photos, dimensional drawings, and specifications table make up the illustrations. Spencer Turbine Co.

194 **Stainless in Chemical Work**—Form SS11, 36 pages, describes the varied and many uses that stainless steel finds in the chemical and petroleum industries. Photos, drawings of all kinds, tables of corrosion resistance, and the properties of stainless as made by this firm is listed. Allegheny Ludlum Steel Corp.

Electrical Contacts

In the article "Electrical Contacts" cuts for Fig. 2, page 21, were inadvertently transposed. Contacts with the Elkonite inserts are shown by the photograph at the left, the badly burned copper contacts at the right.

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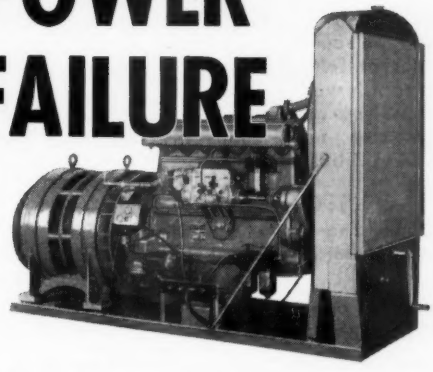

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